Sanitation and Water for All (SWA): Mapping WASH actors in Indonesia using Social Network Analysis

Institute for Sustainable Futures for Sanitation and Water for All (SWA)

About the authors

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The Centre for Regulation Policy and Governance (CRPG) is an independent think tank based in Bogor, Indonesia. CRPG is an Association with Legal Entity (*Perkumpulan Berbadan Hukum*) established through the approval of the Minister of Justice and Human Rights No. AHU-0027408.AH.01.07.TAHUN 2016. The program aims to enhance the capacity of government reformers and civil society activities in both member and non-OGP member countries in Asia Pacific through peer to peer learning exchange. For further information visit: https://crpg.info/

Research team

Dr Rebecca Cunningham
University of Technology Sydney, Institute for Sustainable Futures

Dr Mohamad Mova Al'Afghani
Centre for Regulation Policy and Governance (CRPG)

Nishrin Azzely Qowwamuna
Centre for Regulation Policy and Governance (CRPG)

Dr Keren Winterford
University of Technology Sydney, Institute for Sustainable Futures

Prof Juliet Willetts
University of Technology Sydney, Institute for Sustainable Futures

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Institute for Sustainable Futures
University of Technology Sydney
PO Box 123 Broadway, NSW, 2007
www.isf.edu.au

Contents

Introduction

This report is part of a broader project undertaking research for the global partnership Sanitation and Water for All (SWA) which is led by former UN Rapporteur for the Human Rights to Water and Sanitation. The focus is on mutual accountability and how to enable multi-stakeholder engagement on commitments made at national and international level to improve water and sanitation services.

An online survey was co-designed and developed with project partners. This online survey provided researchers with information regarding what WASH organisations participants interacted with nationally.

Networks are all around us, from electrical grids (including the poles and wires), towns and cities connected by roads and highways, even inside us, our brains are a labyrinth of neurological connections and pathways.

Social networks are those that relate to humans and how we are connected. People connect with each other in a variety of ways, from being kin, to working together, or being members of the same club. At an organisational level, we may share goals, information and collaborations.

Social network analysis (SNA) is an approach explores these connections; it allows quantitative analysis and qualitative insights into interactions between individuals or nodes (Prell, 2012; Cunningham et al., 2014). SNA has been used in a variety of domains, and although some of the terminology may change, the principals and metrics are the same (Prell 2012).

Metrics such as multiple cohesion measures and key players can be calculated to identify nodes with potential to reach critical nodes in the network.

Within this study, Social Network Analysis (SNA) was used to analyse and visualise the network structures and connections of members to explore:
- the connections between organisations
- whole of network cohesion measures
- discovering optimal diffusion channels

The following outlines the methods and results of this project in regards to the SNA findings followed by a brief discussion, conclusion and potential next steps.

Method

Ethics

An online survey that included questions to respond to the key evaluation questions and social network analysis questions was the primary data collection tool for this report. Within this project, best practice was undertaken when informing participants about the research aims and informed consent.

The anonymised survey data was used by the research team to prepare this report and also to identify potential individuals for further contact in the form of an interview as part of the broader evaluation process. As part of the University's obligation to the Australian Code for the Responsible Conduct of Research and the National Statement on Ethical Conduct in Human Research, this research received ethical approval from UTS Human Research Ethics Committee (HREC) through the UTS: ISF ethical procedure.

Data protocols

Data was kept in a Dropbox folder with the research team (named as authors) and Dropbox super users to access. In order to protect anonymity and to satisfy the needs of this project, participants listed organisation name and role. Organisation names only will be listed within this report. Further, the aggregated findings are described in ways to prevent individuals to be identified (e.g., geographical location.) Data has been managed in order to protect the privacy, confidentially and cultural sensitivities of all workshop participants. Research data has been stored on the UTS: ISF server which is only accessible by UTS: ISF employees through individualised passwords. All data stored on the server will be de-identified and master identifying lists will be password protected.

All versions of files on the UTS: ISF Dropbox sever are backed up for a period of 120 days, i.e. any version of a file created in this period is recoverable if deleted. Deleted files can be restored through the Dropbox interface, either by file name or by user event. Dropbox also provides priority email and live chat support for more complicated restorations.

Recruitment

Recruitment for the survey was targeted through key agents identified by the SWA partners in Indonesia.

Distribution of the online survey was sent out by email to targeted organisations that engages in WASH policy and programs. In order to enhance completion, additional reminder emails were sent. The survey took place in November 2020. In order to expand the sample, two additional surveys were undertaken by two Indonesian partners over the phone.

SNA Procedure

Within the online survey, Partner Organisations were asked to nominate their organisation type. Organisation types included:

- Government - national;
- International NGO;
- Local NGO;
- Development Partner or UN agency;
- Research or Educational organisation;
- Private Sector Organisation.

Partner Organisation (POs) participants were asked who their organisation had worked in the WASH sector at the national level. Researchers and project partners then categorised the organisation types of the responses. This resulted in additional organisation type categories of

- Association;
- Network;
- Program.

Partner Organisation (POs) participants were asked how frequently they interacted with these organisations from the following options of weekly, monthly, quarterly, annually, or other. The majority of the "other" responses were "as needed". In order to apply a strength of tie to the frequency of interaction, a value was issued to each of the responses. The value for each of the responses were:

- Weekly = 8
- Monthly = 6
- Quarterly = 4
- Annually = 2
- Other / as needed = 1

Data from these questions was used to create a directed and valued symmetric matrix[1] that can be analysed and visualised using social network analysis (SNA). Each Partner Organisation and nominated organisation is represented by a node (or dot) and every interaction is represented by a tie (or line).

As the responses were aggregated to the organisation level, the names of the organisations have been included. For clarity within the visualisations acronyms have been used. Please refer to Table 4 for full list of node acronyms and organisation names as a reference.

SNA Analyses and visualisations were run in SNA software packages, UCINet (Borgatti, Everet et al. 2002) and Netdraw (Borgatti 2006). The visualisation layout (Figure 1 ,2, 4 & 5) uses geodesic distance[2] to position the nodes. This means that the layout tries not to have any lines overlapping, the nodes with more nominations (e.g., higher in-degree) are more central to the figure and nodes with similar structural positions are forced together. In Figure 3, the layout was forced to bring nodes together that shared similar attributes (e.g., organisation type).

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[1] A symmetric matrix is a square matrix that is equal to its transpose. In this instance the matrix is directed as the participants of the survey are nominating other organisations they work with. Therefore, the ties between nodes are directed. This is indicated in the figure by arrows
[2] Geodesic distance is the shortest distance between two points.

DEFINITIONS SNA KEY TERMS:

Below, we use common terms for SNA which are described simply here:

Node: any entity within the network. All POs and their partner organisations are represented by a node. Within the visualisations, nodes appear as dots.

Tie: every connection between nodes is represented by a tie.

Average degree is the average number of links within the network.

Density is the total number of connections divided by the total number of possible connections in the network.

Connectedness is the proportion of nodes that can reach each other by some path

Fragmentation is the proportion of nodes that can't be reached by a path.

Diameter estimates the number of steps to reach everyone within the large component within the network, i.e. 'Bacon's Law' and 'six degrees of separation'(Cunningham, Jacobs et al. 2017).

In-degree is the number of incoming ties

Out-degree is the number of outgoing ties

Keyplayer is a sub package of UCINET (Borgatti, Everet et al. 2002). The Keyplayer analysis involves utilising a diffusion algorithm with the aim of reaching every node in the network. It selects three initial nodes, and takes two steps into the network, offering up to 10 different arrangements of nodes that will reach the maximum percentage of all nodes within the network (Borgatti 2006).

Results

Mapping WASH organisations in Indonesia with Social Network Analysis (SNA)

In order to map the influential partner organisations with social network analysis (SNA), participants were asked to list the top 10 WASH organisations they had worked or interacted with as well as the frequency of interaction. These questions allowed for the development of a directed, valued symmetric matrix allowing for analysis using the software suite developed for SNA: UCInet and Keyplayer (Borgatti, Everet et al. 2002) utilizing the metrics outlined above.

In regards to the approach, it is best for the highest possible responses rate with any SNA survey. This often requires an iterative approach, wherein all organisations that POs named would be contacted and have the opportunity to complete this survey. This was outside of the scope of this project and this is a limitation in the potential to interpret the SNA measures in a more fulsome manner. As such it is important to note that there is missing data, and the results are skewed towards those organisations that did participate in the survey. Although the results presented here will not be a representative picture of the sector, as this is an exploratory pilot study, the results may provide some qualitative insight into the current interactions of these institutions.

As this is a exploratory pilot study, rather than a longitudinal study, the quantitative metrics are best read in concert as each tells a part of how the network is structured. Within this section the results will be stated followed by a brief discussion of what this may indicate for this network. The deeper interpretation of these results reserved for the Discussion and Conclusion section of this report, after the visualisation section.

Node and network considerations

Survey participants totalled O= 12. Ten of the participants completed the online survey, while a further 2 were engaged by the Indonesian partner to complete over the phone. Participants nominated 42 national level WASH organisations that they worked with in Indonesia, resulting in a total of N= 54 nodes.

Node attributes – Organisation Type

In addition to analysing the connections between organisations, various attributes of both the Partner Organisations (POs) and PO partner organisations were collated into categories. All nodes were categorised by organisation type. As this SNA is partial (with not all nominated nodes completing the survey), there is a category for "Completed Survey" and "Not completed Survey". Note, in the visualisations this means that those who completed the survey appear as circles and those that did not complete the survey appear as squares.

In addition, there are two further categories:

1) Organisations that are members of SWA and are active in SWA activities:

- BAPPENAS
- UNICEF
- CPRG

2)   Organisations with offices in Indonesia that are SWA members at international level:

- Water.Org
- UCLG
- SNV
- Plan
- GWP
- DFAT
- DGIS
- World Bank

As their formal positions within the network may impact their structural positions, these organisations are depicted within Figure 2 as SWA members (up triangles) and Organisations with Indonesian offices (down triangles).

Table 1 lists the total numbers of both POs and PO partners per organisation type. POs identified themselves primarily as Development partner or UN agency (4), Research or Educational organisation (2), Local NGO (2), Government –national (1), International NGO (1), Private Sector Organisation (1) and Program (1) (see Table 1).

Partners of POs varied with the largest coming from Government – national (12), Development partner or UN agency (7), International NGO (6) , Local NGO (5), Association (3), Network (3), Private Sector Organisation (2), Research or Educational organisation (2), and Program (2) (see Table 1).

Table 1: Partner Organisation (POs) and PO partners categorised by Organisation type

Organisation Type	POs - Number of nodes per org type	Partners of POs- Number of nodes per org type	Total Nodes per org Type	Org Type colour in visualisations
Association	0	3	3	Light Grey
Development Partner or UN agency	4	7	11	Orange
Government - national	1	12	13	Dark Green
International NGO	1	6	7	Dark Blue
Local NGO	2	5	7	Light Blue
Network	0	3	3	Dark Grey
Private Sector Organisation	1	2	3	Black
Program	1	2	3	Light Green
Research or Educational organisation	2	2	4	Red

Multiple Cohesion Measures

UCINET's whole network multiple cohesion measures, key player 'diffuse' and in and out-degree centrality algorithms were used to analyse how organisations interacted. Definitions are provided above on page 7.

The total number of nodes for this network was N= 54 with a total number of ties n=109. This indicates that there were more nodes that there were connections, indicating that POs have multiple partner organisations.

Average degree is the average number of links in the whole network (counting both in-degree and out-degree). The average degree was 2.019.

Density is the total number of connections divided by the total number of possible connections in the network or expressed mathematically as *n(n-1)/2*. The density of this network was 0.038.

Connectedness within this network was rated as 0.118 with a fragmentation figure of 0.882 demonstrating that this a fragmented network.

Diameter estimates the number of steps to reach everyone within the large component within the network, i.e. 'Bacon's Law' and 'six degrees of separation'(Cunningham, Jacobs et al. 2017). The diameter of the network was 4. As there are four steps to move from one side of the network to the other, this may illustrate that there may be nodes acting as 'hubs' within the network. Hubs are often nodes with high in-degree centrality.

Table 2: Multiple Cohesion Measure Metrics

Metric	
# of nodes	54
# of ties	109
Average degree	2.019
Density	0.038
Connectedness	0.118
Fragmentation	0.882
Diameter	4

Keyplayer

The Keyplayer analysis involves utilising a diffusion algorithm with the aim of reaching every node in the network. It selects three initial nodes, and takes two steps into the network, offering up to 10 different arrangements of nodes that will reach the maximum percentage of all nodes within the network. In this instance the results demonstrated that with the initial nodes of Aksansi, CRPG and GwP. The algorithm settled on an arrangement of the CRPG, Aksansi and APPSANI that could reach 84% of the network – more than three quarters. This illustrates that there are hubs active in the network and these organisations may act as knowledge brokers to those further out of the network.

Table 3. Key player (diffuse) in the AVP network

Key player query run	Key player (diffuse)	Key player (diffuse)	Key player (diffuse)	Nodes reached (%)
1	CRPG – Research or Educational organisation	Aksansi (Local NGO)	APPSANI (Private Sector Organisation)	84%

In-degree and Out-degree Centrality

Individual in-degree (number of incoming ties) and out-degree (number of outgoing ties) were calculated for each node. Table 4 outlines degree centrality for all nodes sorted by in-degree centrality (IDC) (highest to lowest) and out-degree (ODC) centrality (highest to lowest). As the strength of tie was valued, both the sum of the value of the ties (_V) and the dichotomised (_D) figures are listed. The dichotomised values illustrate the actual number of participant organisations that named them as a WASH partner.

The importance of demonstrating in-degree centrality is that is shows those nodes that may be acting as knowledge brokers between other nodes in this network. Within Figure 1 & 2 the nodes with higher in-degree are larger in size.

The importance of demonstrating out-degree centrality is it shows the reach of the PO to their partner organisations. It is important to note that within this survey there were only 10 fields for partner organisations so it may be possible that some organisations (particularly those that listed 10) may work with more than 10 partner organisations. Within this table the column "Node Label" lists the code that is used within Figures 1 & 2.

Table 4: Out-Degree Centrality (ODC) and In-degree Centrality (IDC) figures for Valued (_V) and Dichotomised (_D) matrices

Node Label	Organisation Name	ODC_V	IDC_V	ODC_D	ICD_D
UNICEF	UNICEF	62	38	10	7
Bappenas	Bappenas Ministry of National Development Planning of the Republic of Indonesia	38	33	10	7
Kemenkes_H	Ministry of Health	0	27	0	7
PU	Ministry of Public Works and Housing	0	27	0	6
SNV	SNV	56	23	11	6
World Bank	World Bank	34	22	11	5
WV	World Vision	0	17	0	5
Plan	Plan	0	13	0	5
IUWASH	IUWASH	60	12	9	4

USAID	USAID	0	16	0	3
SIMAVI	SIMAVI	0	12	0	3
Pokja	Pokja AMPL Network	0	9	0	3
GIZ	GIZ	0	16	0	2
Jejaring	Jejaring AMPL	0	14	0	2
Forkalim	FORKALIM	0	12	0	2
Kemendikbud	Ministry of Education and Culture	0	10	0	2
ADB	ABD	0	10	0	2
DFAT	DFAT - Australian Embassy Jakarta	43	8	9	2
WHO	WHO	0	8	0	2
JICA	JICA	0	8	0	2
KIAT	KIAT Program	0	6	0	2
DSDAN	National Water Resources Council	0	3	0	2
Kemenag	Ministry of Religious Affairs	0	8	0	1
Kemenkeu_F	Ministry of Finance	0	8	0	1
Borda	Bremen Overseas Development Agency	0	8	0	1
Perpamsi	PERPAMSI	0	6	0	1
KAI	Indonesia Water Partnership	0	6	0	1
Pamsimas	PAMSIMAS Program	0	6	0	1
Water.org.	Water.org	0	6	0	1
GWP	Global Water Partnership Southeast Asia	28	4	10	1
Speak	SPEAK	0	4	0	1
BEST	BEST	0	4	0	1
LPTP	Lembaga Pengembangan Teknologi Pedesaan	0	4	0	1
Akkopsi	AKKOPSI	0	2	0	1
KLHK	Ministry of Environment and Forestry	0	2	0	1
Kemendagri	Ministry of Home Affairs	0	2	0	1
ITB	ITB	0	2	0	1
Danone	Danome	0	2	0	1
TBN	TBN (Transformation Business Network)	0	2	0	1
PJB	PJB (Pembangkit Jawa Bali)	0	2	0	1
MCC	MCC	0	2	0	1
KFW	KFW	0	2	0	1
CRPG	CRPG	27	1	9	1
StCH	Save the Children	0	1	0	1
ESDM	Ministry of Mining and Energy	0	1	0	1
Kruba	Koalisi Rakyat untuk Hak Atas Air	0	1	0	1
BPPSPAM	National Agency for Drinking Water Support	0	1	0	1
UGM	Universitas Gajah Mada	0	1	0	1
Kemendes_VD	Ministry of Village Development	0	0	0	1
Kemenkeu_E	Ministry of Economic Affairs	0	0	0	1
FTUI	Universitas Indonesia	28	0	9	0
APPSANI	Naga Kencana -APPSANI	26	0	8	0
Amrta	Amrta Foundation for Water Literacy	4	0	4	0
Aksansi	Asosiasi KSM Sanitasi Seluruh Indonesia	30	0	9	0

Netdraw visualisations – Mapping WASH networks Indonesia

When the networks are visualised it shows the network structure as well as demonstrating the power of the nodes with high in-degree (large central nodes). This is a visual representation of the directed-symmetrical matrix developed from the survey questions. As previously noted, the visualisation layout in both figures uses geodesic distance to position the nodes. This means that the layout tries not to have any lines overlapping, the nodes with more nominations (e.g., higher in-degree) are more central to the figure and nodes with similar structural positions are forced together. For this project, the same network is visualised four times in order to highlight

1. The attributes of the organization type and those with high in-degree centrality (Figure 1)
2. Identifying SWA members and Organisations that are members of SWA and are active in SWA activities as up triangles and organisations with offices in Indonesia that are SWA members at international level as down triangles (Figure 2).
3. The interaction between organisation type (Figure 3). Here the layout has been forced to the attribute of organisation type, so that those who are of the same organisation type are clustered together.
4. The frequency of interaction or strength of ties between organisations (Figure 4). In this figure, the more frequent the interaction, the thicker the tie between the two organisations.
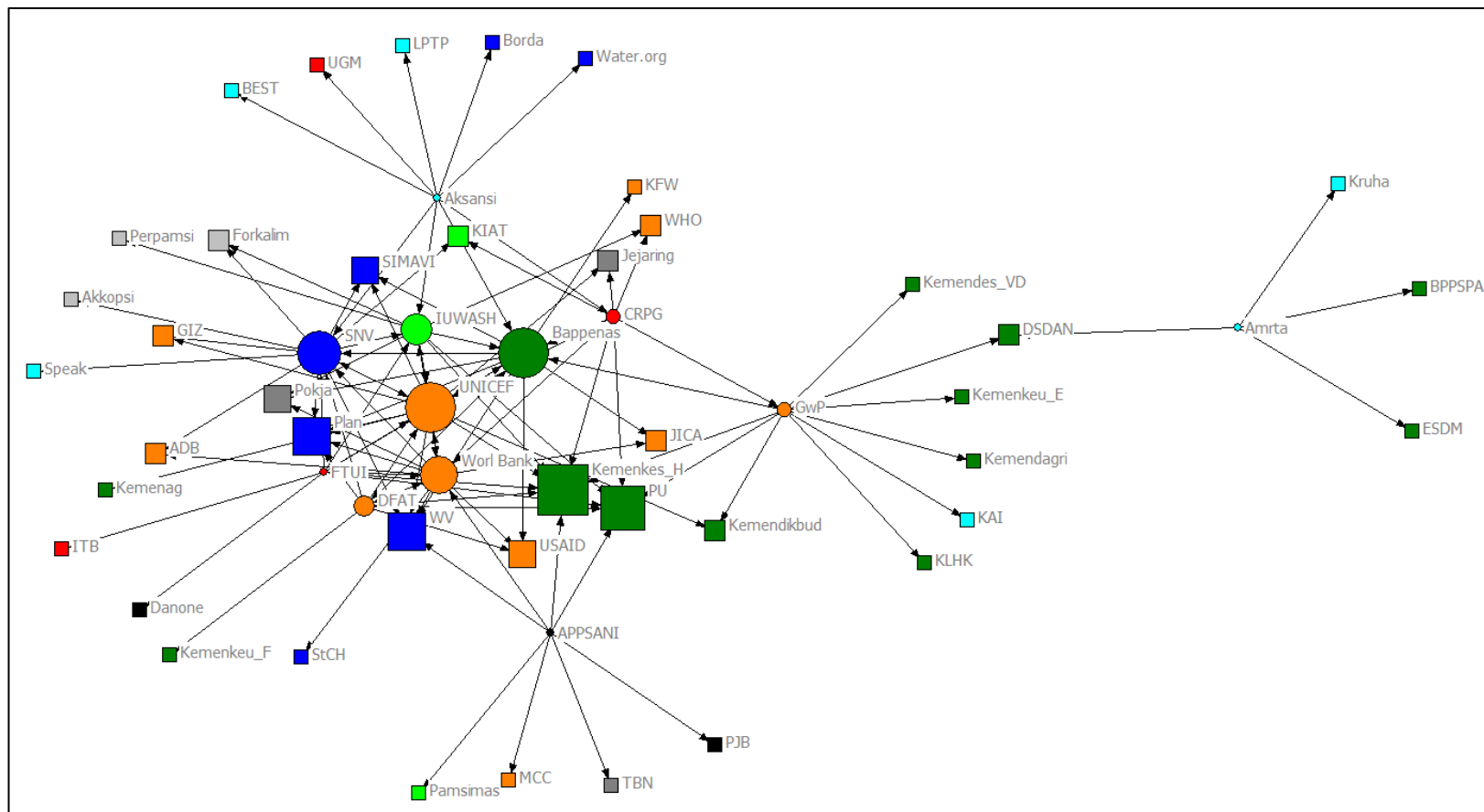5. The keyplayers in are illustrated by triangles (Figure 5).

Figure 1: Visualisation of WASH Indonesia network: Organisation Type

Table 5: Legend Figure 1

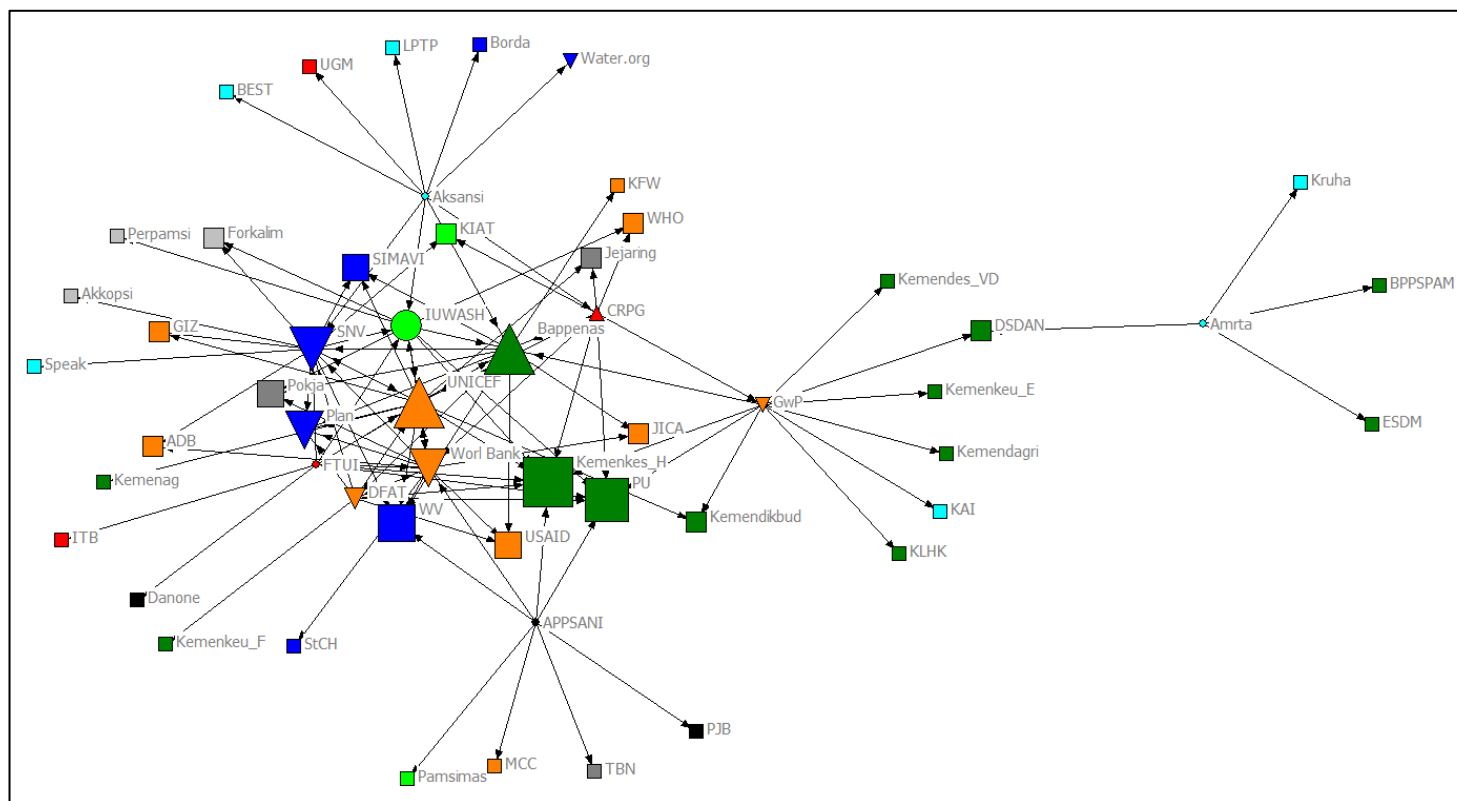| NODE COLOUR REPRESENTS ORGANISATION TYPE:				
Association = Light Grey	Development Partner or UN agency = Orange	Government national = Dark Green	International NGO = Dark Blue	Local NGO = Light Blue
National Program = Light Green	Network = Dark Grey	Private Sector Organisation = Black	Research/Education institute = Red	
SHAPE REPRESENTS ORGANISATION COMPLETION OF SURVEY				
Completed survey = Circle		Did not complete survey = Square		
SIZE OF THE NODE DENOTES IN-DEGREE:				
The larger the node, the greater the in-degree of that node.				

Figure 2: Visualisation of WASH Indonesia network: SWA members and Organisations with offices in Indonesia

Table 5: Legend Figure 2

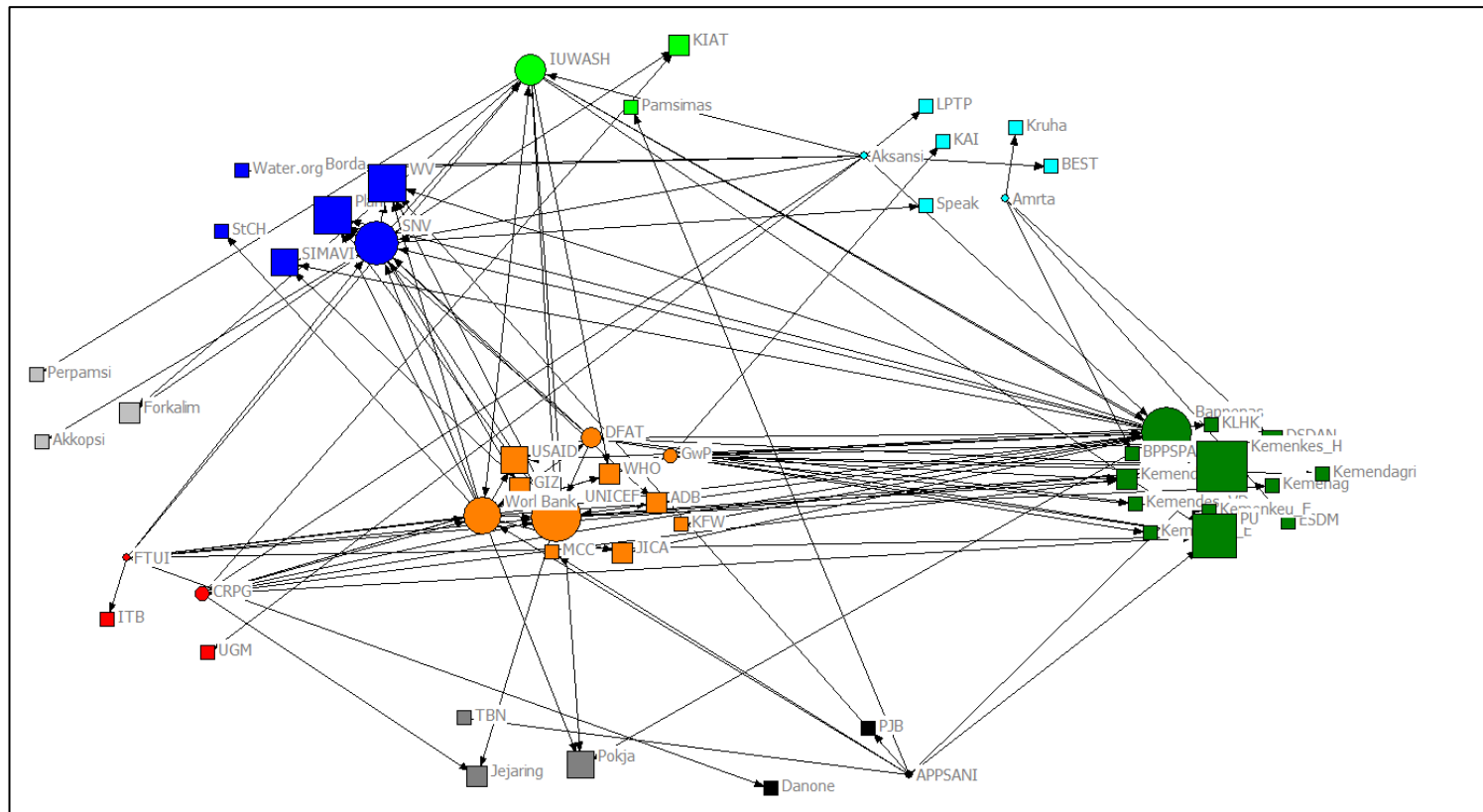| NODE COLOUR REPRESENTS ORGANISATION TYPE:				
Association = Light Grey	Development Partner or UN agency = Orange	Government national = Dark Green	International NGO = Dark Blue	Local NGO = Light Blue
National Program = Light Green	Network = Dark Grey	Private Sector Organisation = Black	Research/Education institute = Red	
SHAPE REPRESENTS ORGANISATION COMPLETION OF SURVEY				
Completed survey = Circle	Did not complete survey = Square	SWA members = Up triangle		Organisations with offices in Indonesia = Down triangles
SIZE OF THE NODE DENOTES IN-DEGREE:				
The larger the node, the greater the in-degree of that node.				

Figure 3: Visualisation of WASH Indonesia network: Forced layout to Organisation Type

Table 6: Legend Figure 3

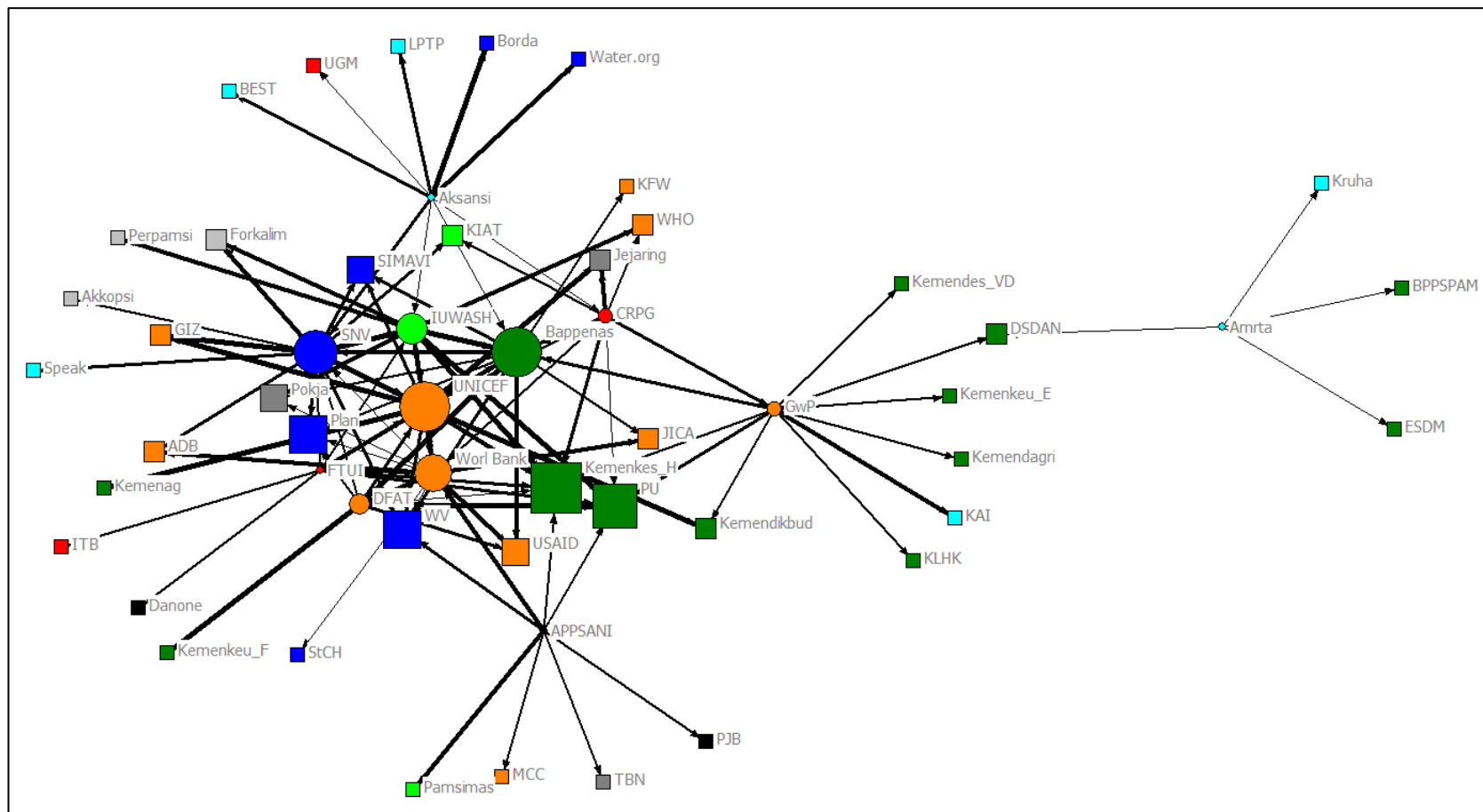| NODE COLOUR REPRESENTS ORGANISATION TYPE:				
Association = Light Grey	Development Partner or UN agency = Orange	Government national = Dark Green	International NGO = Dark Blue	Local NGO = Light Blue
National Program = Light Green	Network = Dark Grey	Private Sector Organisation = Black	Research/Education institute = Red	
SHAPE REPRESENTS ORGANISATION COMPLETION OF SURVEY				
Completed survey = Circle		Did not complete survey = Square		
SIZE OF THE NODE DENOTES IN-DEGREE:				
The larger the node, the greater the in-degree of that node.				

Figure 4: Visualisation of WASH Indonesia network: Tie Strength

Table 7: Legend Figure 4

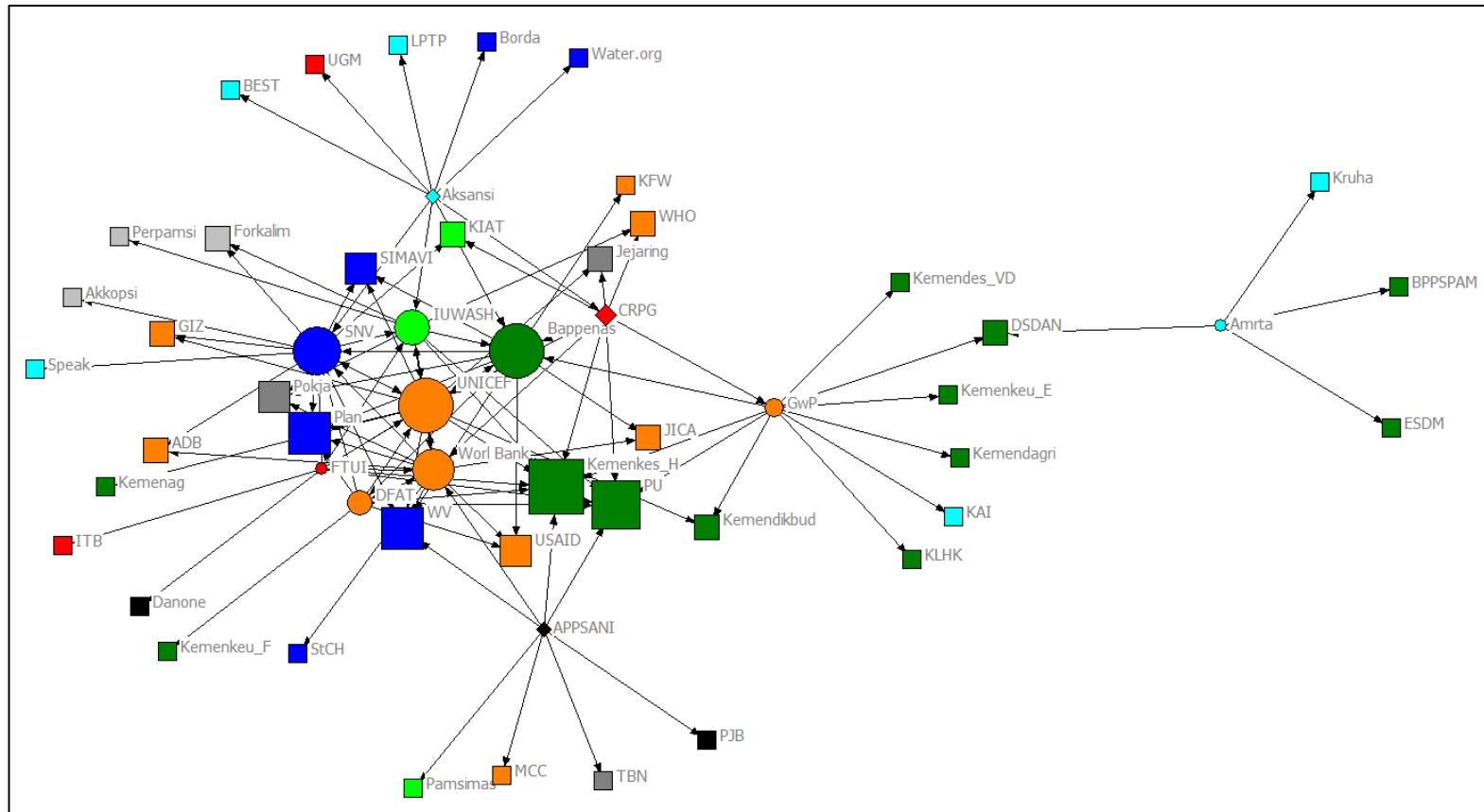| NODE COLOUR REPRESENTS ORGANISATION TYPE:				
Association = Light Grey	Development Partner or UN agency = Orange	Government national = Dark Green	International NGO = Dark Blue	Local NGO = Light Blue
National Program = Light Green	Network = Dark Grey	Private Sector Organisation = Black	Research/Education institute = Red	
SHAPE REPRESENTS ORGANISATION COMPLETION OF SURVEY				
Completed survey = Circle		Did not complete survey = Square		
SIZE OF THE NODE DENOTES IN-DEGREE:				
The larger the node, the greater the in-degree of that node.				
THICKNESS OF THE LINE DENOTES STRENGTH OF TIE:				
The thicker the tie, the thicker the line and the more frequent interaction between the two organisations				

Figure 5: Visualisation of WASH Indonesia network: Keyplayer

Table 8: Legend Figure 5

NODE COLOUR REPRESENTS ORGANISATION TYPE:			
Association = Light Grey	Development Partner or UN agency = Orange	Government national = Dark Green	International NGO = Dark Blue	Local NGO = Light Blue
National Program = Light Green	Network = Dark Grey	Private Sector Organisation = Black	Research/Education institute = Red	
SHAPE REPRESENTS ORGANISATION COMPLETION OF SURVEY			
Completed survey = Circle		Did not complete survey = Square	Keyplayer = Diamond
SIZE OF THE NODE DENOTES IN-DEGREE:			
The larger the node, the greater the in-degree of that node.			

Discussion and Conclusion

It is important to acknowledge that this SNA is a quantitative analysis undertaken with qualitative instruments, being the online survey. Although there were 12 responses, ideally it would be best within a SNA survey for there to be an iterative approach, wherein, all organisations that POs named would be contacted and have the opportunity to complete this survey. This was outside of the scope of this project and this is a limitation in the potential to interpret the SNA measures in a more fulsome manner. It is also important to note that social networks offer a snapshot in time of the interactions that exist, in this instance, between Partner Organisations and the organisations they have worked with. Networks are not quantitatively comparable unless there is a longitudinal survey of the same actors and the same questions have been asked within the survey. If this survey was to be run again at a later interval there could be a point of comparison.

Another limitation and observation is that this 'network' in the WASH sector was not purposefully set up to be a network. Rather, this research was an exploratory enquiry into the interaction between POs and their partner organisations. In addition, as this is an unbound network there is a propensity for lower levels of closure and less connectedness.

From this preliminary exploration, this project demonstrated that National Government (dark green nodes), Development Partners and UN agencies (orange nodes) International NGOs (Dark Blue) are significant information hubs within these network (see Figures 1 & 2 with these nodes being central to the image). A combination of research and educational organisations, alongside Private Sector organisations and Local NGOs play key bridging roles within the network (see Figure 4).

The current network demonstrates low density, high fragmentation and low cohesion with some POs having unique networks that they operate within at the local scale. This may be due to the nature and intention (of lack thereof) of the network. There may be a fundamental operational characteristic that this group of institutions were set up to engage in a collaborative fashion. However, there were "networks" named as WASH organisational actors (dark grey nodes) and "associations" (light grey nodes), which may be useful sources of information distribution, collaboration, coordination and mutual accountability into the future.

It is encouraging to see that the network has a diameter of 4, meaning that it only takes 4 steps to walk through the whole network, and with 3 keyplayers having access to more than three-quarters of the network, this demonstrates that there is a strong core-periphery structure within this network.

Many participants reported to interact with different ministries of national government as well as large development partners. It is important to note that as this is at the organisational scale, this participants may be engaging with different personnel within these potentially large organisations.

If desired, there is an opportunity for further diffuse collaboration and knowledge exchange within this network by utilising the keyplayers and those organisations identified with high in-degree centrality. There are often barriers for organisations to undergo knowledge exchange, so it may be useful to strengthen the cohesion of social networks in order to undertake any collaborative governance or knowledge exchange processes (Burch et al., 2014; Crona & Bodin, 2006; Bodin & Crona, 2009; Dowd et al., 2014; Joyce et al., 2013). Finally we wish to

acknowledge that this is a preliminary study and further research would be required in order to further and more fully understand the operation and collaboration between Partner Organisations involved in the WASH sector in Indonesia.

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