Looking at groundwater research landscape of Jakarta Basin for better water management

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Abstract. Based on our experience, defining the gap between what we know and what we don’t know is the hardest part in proposing water management strategy. Many techniques have been introduced to make this stage easier, and one of them is bibliometric analysis. The following paper is the second part of our bibliometric project in the search for a gap in the water resources research in Jakarta. This paper starts to analyse the visualisations that had been extracted from the previous paper based on our database. Using the keyword “groundwater Jakarta”, we managed to get 70 relevant papers. Several visualisations have been built using open source applications. Word cloud analysis shows that the trend to discuss groundwater in scientific sense had only been started in the early 2000’s. This is presumably due to the emerging regional autonomy in which forcing regions to understand their groundwater setting before creating a management strategy. More papers in the later time has been induced by more geo-hazards (land subsidence and floods) resulted in the vast groundwater pumping. More and more resources have been utilized to get more groundwater data. Water scientists by then understood that these hazards had been started long before the 2000’s. This had become the starting point of data era later on. The next era will be the era of water management. Hydrologists had been proposing integrated water management Jakarta and its nearby groundwater basins. Most of them have been strongly suggested to manage all water bodies, rainfall, surface water, and groundwater as one system. In the 2010’s we identify more papers are discussing in water quality following the vast discussion in water quantity in the previous era. People have been more aware the importance of quality in providing water system for the citizen. Then five years later, we believe that water researchers have also put their mind in the interactions between surface water and groundwater, especially in the riverbank, where most of the slums are located. Based on the results, we believe that more researches to understand interactions between groundwater and surface water would fill the gap to come up with better water management system in Jakarta.

1. Introduction

Topic modelling and network visualization is a very important for researchers to choose the least discussed topic and the gap in between research topics. To solve the problem, we need to have a systematic extraction of topics and visualize it for easy analysis[1,2]. This paper analyses the results
from topic modelling and its visualizations using open source applications: VosViewer[3] and Zotero and PaperMachine plug in[4,5]. We brought a case in hydrogeological science, which presents research landscape in Jakarta area. The work discussed in this paper was mainly derived from our previous paper[6], which show case our topic modelling technique.

2. Methods
This paper is the second part of our bibliometric work in which the first paper had been published in RioJournal[6]. We’re then try to give more analysis based on the word cloud plots presented in the paper. We extract a reference database in RIS format[8] using VosViewer software[9,10]. The original dataset and plots are available on our Figshare Repository[7].

3. Word cloud
The basis of this analysis is the following word cloud plot using VosViewer software (Figure 1). The trend to discuss groundwater in scientific sense had only been started in the early 2000’s. This is presumably due to the emerging regional autonomy in which forcing regions to understand their groundwater setting before creating a management strategy. Before 2000’s, groundwater is placed as non-economical goods.

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4. Word connection
Using Zotero reference manager, we managed to build word connections in the paper collections (Figure 2). We thought this tool is very useful to understand the nature of papers when they were written, instead of only relying on the keywords. We can see that the word urban is highly connected to floods, ecosystem, development, river, and river-rehabilitation. This, in a way, is referring the impacts of urban development to the change of ecosystem, the modification of river environment, and the rising frequency of flood hazards.

Another word connection, “land – subsidence”, would be another way to look into the impact of excessive groundwater pumping, as has been in the perception of many since the early 2000’s. We don’t argue that this perception is vague, but this is likely due to the lack of researches in this subject. However more maps have been generated to identify the distribution of land subsidence, and try to connect the findings with the distribution of groundwater pumping.

The next observed word connection is “groundwater - interactions, management, age, excessive (pumping)”. This indicates the rising awareness of groundwater as part of public goods, which needs
to be managed. Hence defining its interaction with physical and social environment is very important. More problems in “water – supply” and “water – quality” are also important since more people means more water demand in high quality. Another word pair “subsurface – environments” is also notable in the plot. This is very interesting to us that the rising environmental problems before 2000’s have never been connected with subsurface environment. Regional planning documents released before 2000’s have been only occupied mainly by surface environment.

Figure 1. Word cloud from the year 2004 to 2015. It shows the setting of groundwater research in each interval.
5. Concluding remarks
We believe that the year 2000 is the major milestone of groundwater research in Jakarta area, with the rise of regional autonomy. Our visualizations of bibliometric data shows that groundwater before 2000’s has only been placed as non-economical goods, which then shifted as the major spot of economical goods after the 2000’s. Such shifting has resulted to many geo-hazards, as perceived by the community. More and more unique keywords and word connections can be extracted since then with more environmental complication and social interaction. We also believe that more research should be directed to groundwater and river/surface water interaction to understand the nature of water quality in such megacity like Jakarta.

Another take home note that we want to deliver is the importance of open source resources in academic life. More open source applications have been built to support researchers with lack of funding and sponsor. These open source applications as well as open source movement also embraces the power creativity and networking among academia.

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