Review Article: a systematic literature review of research trends and authorships on natural hazards, disasters, risk reduction and climate change in Indonesia

Riyanti Djalante [1,2,3]

5 [1]United Nations University – Institute of Environment and human Security, Bonn, 53117, Germany
[2] United Nations University – Institute for the Advanced Study of Sustainability, Tokyo, 150-8925, Japan (Current Affiliation)
[3] University of Halu Oleo, Kendari, 93111, Sulawesi Tenggara, Indonesia

Correspondence to: Riyanti Djalante (djalante@unu.edu)

10 **Abstract.** Indonesia is one of the most vulnerable countries from disasters and climate change. While there has been a proliferation of academic publications on natural hazards, risks, and disasters on Indonesia, there has not yet a systematic literature review (SLR) to determine the progress, key topics, and authorships. SLR is important so researchers can build upon existing works, avoid bias, determine major research, need for further research and strengthen research capacity in the future. The author conducts a SLR of publications indexed within the Scopus database from 1900 to 2016 on topics related to disasters

15 and climate change in Indonesia. Two major findings are outlined. The *first* is related to major research topics: (1) natural hazard, risk and disaster assessments (HRD), (2) disaster risk reduction (DRR), and (3) climate change risks, vulnerability, impacts and adaptation (CC). More than half are related to HRD and focus on volcanic eruptions, tsunami and earthquakes. Publications on DRR are related to governance, early warning systems, and recovery and reconstruction. Those on CC discuss carbon emission, forestry, governance, and sectoral impacts. The author calls for future research on different hazards, different

20 locations, and impacts of disasters and climate change. Risks and vulnerability assessments from hydro-meteorological and geophysical hazards are needed. Other locations beyond Sumatera and Java islands are to be examined. Urban risk assessments, and the economic and social impacts of disasters and climate change on vulnerable places and communities are equally important. Risk governance at the national, local and community level are to be strengthened to increase resilience. The *second* finding examines the roles of Indonesian researchers and organizations. Findings show limited progress in research, publication

25 and collaboration. International/ non-Indonesian authors dominate the literature and only half of the publications are co-authored by Indonesians. International collaborations have been conducted by very few Indonesian organizations. These could be due to limited experience in academic collaboration, power play amongst researchers, lack of research capacity, weak English academic writings skills, and limited provisions within higher education system. The author recommends more funding and incentives for collaborations, training on English academic writing and journal article publications, capacity building

30 especially for early career, female and social science researchers, encourages multi-disciplinary collaborations, and strengthening of science communication in social medias and science-policy advocacy.

1 Introduction

Disasters and the associated social and economic impacts are on the rise (EMDAT, 2018). The last decade has witnessed the highest number of and impacts from disasters and 2015-2017 have been the hottest years ever (WMO, 2017). The Asia Pacific region has experienced the highest number of disasters (EMDAT, 2017), within which Indonesia is one of the most at risk countries (EMDAT, 2017). Between 1900 and 2017, there have been 489 disasters in Indonesia caused by natural hazards, almost 242 thousand deaths, 30.7 million people affected and total damage almost 30 Billion USD (EMDAT, 2017). Geophysical disasters caused more than 95% deaths while the hydrological, meteorological and climatological disasters occurred more frequently, affected more people, and caused more damages (EMDAT, 2017). The Sendai Framework for Disaster Risk Reduction (SFDRR) calls for multi hazard, integrated and inclusive approach for DRR and climate change adaptation (CCA) (UN/ISDR, 2015).

Studies on disasters have expanded enormously globally which calls for frequent synthesis of the research trends and topics, issues, challenges and strategies and innovations in dealing with disasters. The role of science in influencing DRR policy is recognized and studies are needed to identify key lessons learnt and policy effectiveness. There is also call for giving more voices and strengthening capacities of local scientists in contributing to the generation of knowledge. It is often that local scientists are left out in internationally research collaborations and publications. The global progress on scholarly publications on disaster science is documented recently in 'A Global Outlook on Disaster Science (Elsevier, 2017). It looks at scholarly outputs and impacts of disaster science according to the SFDRR, and documents productivity of countries in producing scholarly studies. There are more than 27 thousand outputs which represent only 0.22% of the world's output, with China, the United States of America and Japan dominate. Countries that are most at risk tend to have the least number of publications (Elsevier, 2017). Indonesia is part of the countries that produces more specialized outputs in disaster science than global average (Elsevier, 2017). A detailed study that looks at progress of research and roles of researchers in Indonesia is however not yet available.

This paper aims to systematically review literature related to natural hazards and risks, DRR, and climate change vulnerability, impact, and assessments in Indonesia. A systematic literature review (SLR) reviews literature with explicit and transparent methods (Gill and Malamud, 2014). It determines topics that have been heavily researched, build upon others´ existing works and avoid bias (Khan et al., 1996). It gauges when, how and by whom the research has been conducted to formulate future strategies for strengthening research capacity (Mallett et al., 2012). There are two research objectives adopted. *First* is to determine research progress on natural hazards, risks, disasters and climate change in Indonesia within the timeframe from 1900 to 2016. *Second* is to examine the roles Indonesian authors in research, international publications and collaborations. The structure of this paper is as follows. The first section presents the rationale, aim and objectives. Next it outlines the research method. The third section presents results and discussions. The last section outlines recommendations on future research topics and directors and strategies to increase the quality of publications and scientific collaborations in international spheres, along with policy-relevant recommendations.

2 Research method

2.1 Data collection and multi-stage processes

The SLR method has been used in health (e.g. Moher et al., 2009a), software engineering (e.g. Kitchenham et al., 2009), and engineering (e.g. Gosling and Naim, 2009) studies. There have also been studies that use this form of review in topics related

5 to natural hazards, disasters, and climate change. These include reviews of different natural hazards such as droughts (Woodhouse and Overpeck, 1998), landslides (Aleotti and Chowdhury, 1999), wildfires (Neale and Weir, 2015), tsunami (Chiu and Ho, 2007), and the interactions of those natural hazards (Gill and Malamud, 2014). Others focuses on the impacts (Hunt and Watkiss, 2011) and ecosystem-based adaptation (Brink et al., 2016; Kabisch et al., 2015), education (Johnson et al., 2014), health and psychology after disasters (Kõlves et al.; Harada et al., 2015), volunteerism (Whittaker et al., 2015), and

10 disaster management (Beerens and Tehler, 2016; Lettieri et al., 2009; Gall et al., 2015). A significant work using SLR on climate change studies were done by Berrang-Ford et al (2015; 2015; 2012). The author adopted their recommendations for an SLR mainly to outline the research questions and aims, data sources and document selection, and analysis and presentation of results. The author conducted a multi-layered literature review to determine inclusion and exclusion for more relevant findings to study publications using the Scopus research engine on publications by February 26th, 2016., with a timeframe from

15 1900 to 2016. Scopus was selected because it has the largest database of peer-reviewed literature (Leydesdorff et al., 2010) and capability for search, discovery and analysis (Scopus, 2016b).

- In the first stage, the author uses key research terms of *natural hazard, disaster, disaster management, disaster risk reduction, climate change, climate change adaptation, resilience, vulnerability, geology,* and *Indonesia*. The keyword *geology* was added to capture some of the earliest and significant publications on Indonesia which uses the keywords

20 geology and volcanology. This gave *8077* publications.

- The second stage involves exclusions to further refine the results. The exclusion included refinement in subject areas, document types, and source title which did not directly related to the topics. This gave *3447* publications.

- The final stage involves exclusion of those research in the mining industry in Indonesia, those discussed the science of climate change in very general scope and those that touch on the issue of disasters but not specifically in Indonesia. Further

25 exclusions are warranted when the author judged the scope was too broad. The author downloaded the results into xml format, saves and imports them into Microsoft Excel. When importing into Excel format the author chose all delimiters to ensure information went into the right column. However, the results were not always consistent and hence a manual check on each entry row was needed. The author found the number counts on the authors´ publications and citations presented in the Scopus search were sometimes different to the actual check of the Excel sheet. Hence, to ensure

30 consistency, higher number of publications and citations were selected. The results in the Excel format were examined line by line to further determine exclusion from the lists. Finally, there were *921* materials selected. Table 1 summarizes the results.

Table 1: Multi-Stage Processes for Inclusion and Exclusions for Search Terms

2.2 Data Analysis

The final list was analysed in terms of topics and sub-topics of research citations, keywords, places of focus, types and time of publications, impact factors and authorships. The author used Scopus features to analyse search results such as the article metric module, citation overview, and author profile pages (Scopus, 2016b). The progress of Indonesian scholars was evaluated through counting total number of authors, research outputs and citations overall, and comparing between papers first authored by Indonesians. The author also consulted total citations and publications of researchers in Google Scholar (Google, 2016c), Research Gate (2016) or from other websites to make sure that the full list of publications are captured. It was generally the case that data from a Google search for a publication and author has higher and more up to date citation count. The author checked researchers' organizations, nationalities and genders using Google search.

3 Findings and Discussions

This section is structured into two main parts reflecting the objectives of the paper, first on progress of research in terms of key research topics and timelines, and second on roles of Indonesian researchers and organizations.

3.1 Research Timelines and Topics

The author categorizes the final list into three groups (Table 2), natural hazard, risk, disaster assessments (HRD), disaster risk management and reduction (DRR), and climate change vulnerability, impacts and adaptation (CC), to show and outline how changes in directions on research have taken place over the years and to reduce unbalance towards findings on hazard and risks assessments toward earthquake and volcanic eruption research. In general, there are more research on the topic of HRD (56%), followed by those in DRR (23%), and then CC (21%).

Table 2: Major Research Topics, descriptions and numbers of publications

The paper further identifies key periods and timelines by which publications were published. Although the search timeline was set between 1900 and 2016, the years in which publications were found ranges from 1934 to 2016 (Figure 1).

Figure 1: Number of Publications over the Year

The first period is from the 1934-1990s. There are no significant changes in the numbers of publications produced. The publications on the HRD are some of the earliest publications indexed in Scopus. It heavily focusses on the topics of geophysical hazards and risks related to earthquakes and volcanic eruptions. 22 out of 58 events recorded by EMDAT were earthquakes and volcanic activities (EMDAT, 2016). The Bali earthquakes occurred in 1976 and 1979, which caused 1764 deaths, affected more than 560 thousands people, and costed more than 200 thousands USD in damages (EMDAT, 2016). The year 1979 had the most frequent earthquake (6 times), in Bali, Lombok, and Biak (near Papua) (USGS, 2016). The second period from the 1990s to 2000s shows a notable increase in the literature, up to an average 10 publications per year. This gradual increase corresponds to a rise in literature related to the assessments of HRD and is followed by a sharp increase in

literature to its highest point in 2000. The third period from 2000s-2016 is the most dynamic period for publications. While there is a sharp decline since it first peak in 2000, a surge of publications begins in 2004 in response to the Indian Ocean tsunami which devastated Indonesia the most. This increase has continued ever since. This is also a period which characterize increasing studies on climate-related hazards. A peak occurs between 2010 and 2016. There are 153 publications in 2016 which

5   is the highest in a single year. Publications on HRD and CC are expected to rise. The following sub-sections outline the three topic groups. Within each, the author discusses timelines, areas, and categorization of key topics.

3.1.1 Natural Hazards, Risks and Disasters Assessments (HRD)

The first sub-section explains findings on the topic of hazards, risks and disasters assessments and identifications (HRD). The EMDAT-CRED (2016) categorization of HRD is used, namely geophysical, meteorological, hydrological, and climatological

10   hazards. There are the most frequent and impactful disasters in the country. There are 517 publications in this category. There has been a gradual increase in publications between 1934 and 2000. The first significant is in 2000 of 25 publications and reduced slightly after that. After the 2004 the Indian Ocean tsunami occurred, publications related to tsunami continued to be published until it reaches a peak in 2006. Then in 2009, the publications have increased rapidly ever since, reaching another peak in 2016 of 153 publications. The publications are mostly related to volcanic eruptions, earthquakes and tsunami and the

15   islands of Java and Sumatera are the two areas which receive most attention (more than 70%). The publications are related to volcanic eruptions in Java (almost half) such as Merapi (Verstappen, 1988; Lavigne, 1999; Voight et al., 2000; Andreastuti et al., 2000; Charbonnier and Gertisser, 2008; Gertisser et al., 2012; Suryo and Clarke, 1985), Galunggung (Suryo and Clarke, 1985), Semeru (Siswowidjoyo et al., 1997; Carn, 1999; Thouret et al., 2007; Solikhin et al., 2012), Kelud (Lubis, 2014; Nakada et al., 2016) or Ijen (Heikens et al., 2005; Trunk and Bernard, 2008; van Hinsberg et al., 2010). The next most significant

20   hazard being studied is earthquakes (more than 30%), in terms of how they happened, and methods to assess the impacts. The research on tsunami received gradual attention especially after 2004 (Nakamura, 1980; Nakamura, 1978; Latter, 1981; Koshimura et al., 2009; Imamura et al., 1995). There are also a small number of publications related to landslides (Fathani et al., 2016; Karnawati et al., 2011; Liao et al., 2010). Other hazards discussed include those on flood, strong winds, El-Nino, etc (Figure 2).

25   **Figure 2: Key Topics in HRD Category**

The above findings show that there have been enormous progress publications on this topic. Some of the earliest publications overall also focusses on the characteristics of geophysical hazards and risks. Many publications in this topic are however still focus on geophysical hazards since Indonesia houses some of the most active volcanoes that lies along the "Pacific Ring of Fires" in the world and is located along the fault line of Asian and Australian lines. Studies on the characteristics of earthquakes

30   in terms of hazard assessments are available. What is needed is publications on earthquake risk assessments at the national and smaller scale. The National Agency for Disaster Management (BNPB) has recently developed InaRISK, a web-based service of risk assessments from different hazards (BNPB, 2017). It is however not clear how this information has been utilized for research and most importantly government decision making. The more recent trend of examining hydroclimatic hazards, of

floods, landslides, typhoons is encouraging but still not enough. It is quite surprising that studies on flood hazard and risks assessments are still very limited considering that flood is the most frequent disaster and affected the most people in Indonesia (EMDAT, 2017). Most of studies on floods focusses on the impacts on the societies and how government agencies dealt with the impacts. Considering that the impacts of climate-related disasters are increasingly felt in Indonesia, more hazard and risks

5   assessments on floods, typhoons, wildfires, El-Nino are needed, particularly those that examine trends in the past and project future trends.

3.1.2 Disaster risk management and reduction (DRR)

The second sub-section is on the topic of disasters risk reduction (DRR). DRR include strategies that are aimed at reducing disaster risks and range from risk management to risk reduction. There are 210 publications. There have been very few

10   publications published before 2003. It is only after 2004 that there was a gradual increase of publications. This reached its peak in 2008, after which the number slightly reduced, before continuing to increase. More than half of the DRR publications focus on Sumatera and Java. However, there are also studies that examine Indonesia as part of worldwide, regional or national assessments. The topic that receive most attention in this category is related to the governance of DRR (Bakkour et al., 2015; Chang Seng, 2013; Djalante et al., 2013; Djalante et al., 2012; Guarnacci, 2012; Lassa, 2013). The Indonesian government and

15   other stakeholders are actively contributing for DRR (Chang Seng, 2013; Djalante et al., 2013; Djalante et al., 2012; Lassa, 2013). The next key topic is on the evaluation of recovery and reconstruction that have taken place after the 2004 Indian Ocean tsunami (Chang et al., 2011; Daly and Brassard, 2011; Godavitarne et al., 2006; Guarnacci, 2012; Karan and Subbiah, 2011; Telford and Cosgrave, 2007; Lassa, 2015). Other topics are related to the social implications of disasters; culture, gender or religion in helping community resilience when facing disasters, and impacts of disasters on different community groups

20   including children and woman (Baumann, 2008; Donovan, 2010; Donovan et al., 2012; Gaillard et al., 2008b; Islam and Lim, 2015; Balgos et al., 2012; Guarnacci and Di Girolamo, 2012; Hiwasaki et al., 2015; Siagian et al., 2014; Sagala et al., 2009; Schlehe, 2010). Some topics were related to examination of tsunami early warning system (Schlurmann and Siebert, 2011; Steinmetz et al., 2010). Others examine the role of knowledge and information to help communities be more prepared for disasters (Dicky et al., 2015; Hiwasaki et al., 2015; Rafliana, 2012). There are 13 publications comparing Indonesia and Sri

25   Lanka in regards the impacts of the tsunami on how it either become the precursor for peace process in Indonesia but still take time for the process in Sri Lanka (Enia, 2008; Gaillard et al., 2008a; Hyndman, 2009; Kelman, 2005). Limited numbers examine community-based DRR that are related to community preparedness (Adiyoso and Kanegae, 2013; Birkmann et al., 2015; Hidayati, 2012; James, 2008; Kusumasari and Alam, 2012), and others examine how children are affected psychologically (Du et al., 2012; Lawler and Patel, 2012; Taylor and Peace, 2015; Vignato, 2012), and on emergency

30   management at the local or national level (Esteban et al., 2013; Kusumasari and Alam, 2012; Djalante et al., 2012). Figure 3 summarizes the key topics in DRR category.

Figure 3: Key Topics in DRR Category

The above findings show an encouraging sign on the great variety of research topics related to DRR. This also show a great development and utilization of social science in understanding the impacts of disasters on the society. The author expects enormous development in this topic. This is also where scholars from Indonesia can contribute significantly. Indonesian scholars have most likely lived in Indonesia for a considerable amount of time. They have experienced, assessed and examined

5 those social and environmental changes that have shaped natural hazards and disasters in the first place, which will help them to be more focused and sharp in terms of documenting. It is however very few studies that examine the legal and regulatory implications of disasters on the government planning, program implementation and the society. While there are organizational reports discussing this (e.g. IFRC, 2016), scholarly articles are rare.

3.1.3 Climate Change Risks, Vulnerability, Impacts and Adaptation (CC)

10 The third sub-section is related to climate change risks, vulnerability, impacts and adaptation (CC). The research on climate change is interpreted broadly in this paper. The author included all materials that discuss the impacts of climate change not only on disasters caused by natural hazards but also impacts on different sectors such as agriculture, forestry, water and health. The Sendai Framework for DRR strongly calls for multi-risks perspectives and better integration of DRR and Climate change adaptation (CCA) (UNISDR, 2015). There are 194 publications in this category. There have only been a few publications

15 within the period between 1978 and 1990. The second period between 1990 and 2000 see a slight increase in the literature, with only 5 pieces published in 2001.These are related to examinations of the causes and impacts of forest fires in Indonesia. The numbers of publications do not change in general until 2008. It is only after 2010 that there was a sharp increase in the numbers of publications, reaching its peak in 2015 of 35 papers. The islands of Sumatera and Java has become the two major locations for the research of the climate impacts since they are the areas where the greatest number of paddy fields and crops

20 production is concentrated (McCulloch and Peter Timmer, 2008). There are also increasing research related to climate change impacts on different sectors at various locations in Indonesia such as those in Sulawesi and in the eastern part of Indonesia. The author categorizes the publications in this group into three major discussions on impacts of climate change (almost 60%), the governance of CCA (less than 25%), and deforestation and land degradation.

Since most of materials published in this category are related to the review of the impacts on climate change in Indonesia, this

25 paper takes a deeper on those literatures (Figure 4). The impact on crop production, particularly rice, has been the subject of the majority of climate impact researches (Caruso et al., 2016; D'Arrigo et al., 2011; D'Arrigo and Wilson, 2008; Kawanishi and Mimura, 2015; Keil et al., 2009; Naylor et al., 2001; Sano et al., 2013; Shofiyati et al., 2014) which is strongly associated with droughts (Aldrian and Djamil, 2008; D'Arrigo and Smerdon, 2008; D'Arrigo and Wilson, 2008; D'Arrigo et al., 2006; Keil et al., 2009; Keil et al., 2008). A high number link droughts (Salafsky, 1994; D'Arrigo et al., 2006; D'Arrigo and Smerdon,

30 2008; Shofiyati et al., 2014) and forest fire (Usman and Hartono, 1997; Fang and Huang, 1998; Brauer and Hisham-Hashim, 1998; Jim, 1999; Stolle and Tomich, 1999; Page et al., 2002; Stolle and Lambin, 2003). Studies on water are related to impacts of climate change on ocean circulation (Susanto, 2001), water availability and quality (Rai et al 2015), and water management (Poerbandono et al, 2014), especially those in urban area (Larson et al, 2013) and major river basins (Sahu et al., 2012). Floods

and sea level rise are another topic received strong interest (Marfai and King, 2008; Marfai et al., 2008; Marfai et al., 2015; Muis et al., 2015; Neolaka, 2013, 2012; Sarminingsih et al., 2014; Shrestha et al., 2014), particularly on the impacts on coastal communities and cities (Budiyono et al., 2016; Ward et al., 2013; Firman et al., 2011; Wassmann et al., 2009; Nicholls et al., 1995). The impact of climate change on health is on tropical diseases (Coughlan de Perez et al., 2015) and impacts of increased

5   temperatures on animal (Purnomo et al., 2011; Morwood et al., 2008). Indonesia houses some of the largest of rainforest, in Sumatera and Kalimantan. Forestry issues is discussed in relation to reducing emissions from deforestation and forest degradation, forest conservation and sustainable management, and enhancement of forest carbon stocks (REDD+) (Cerbu, Swallow and Thompson, 2011; Saatchi *et al.*, 2011; Baccini *et al.*, 2012; Margono *et al.*, 2012; Hansen *et al.*, 2013; Minang *et al.*, 2014). A small number of research are on the changing pattern of temperature and rainfall (D'Arrigo and Wilson,

10   2008; Aldrian and Djamil, 2008; Chrastansky and Rotstayn, 2012).

Figure 4: Key Topics in CC Category Researching on Impacts of Climate Change

The above findings show that research on CC has the least progress amongst the other topics. This is an outmost concern considering that Indonesia is one of the most vulnerable countries to climate change (UNU-EHS, 2015). It is however encouraging to see that the range of research in this topic varies in terms of impacts on agriculture, water, health, and forestry

15   sectors. Indonesia is the third largest emitter of Greenhouse gasses emissions especially from deforestation and the situation is reflected in the literature. It is imperative that more studies are needed to understand the vulnerability of the society to climate change, especially since 80% of its population lives along the low lying coastal areas (Neumann et al 2015). Future societal disruptions due to probable loss of livelihoods, environmental migration, climate-induced conflicts needed to be understood. It is also important to equip decision makers on how to deal with climate impacts through mainstreaming in development

20   planning.

3.2 Progress and Roles of Indonesian Researchers and Organizations

This second section examines the roles of Indonesian researchers and organizations in contributing to the production of literature. It first describes some of the earliest literatures and authors on each category. It also addresses to what extent Indonesian researchers have been collaborating with other international/non-Indonesian researchers and organizations, and in

25   producing high impact English journal articles. The roles of authors are examined in general term, and specifically looking at the 10 highly cited papers with Indonesian as first author.

3.2.1 Authorships

The oldest publications listed in Scopus are those by Reinout Willem van Bemmelen, a Dutch national born in Batavia (Netherlands East Indies/Indonesia), on *Ein Beispiel für Sekundärtektogenese auf Java* (An example of secondary isogenesis

30   on Java) (van Bemmelen, 1934) and *Über die Deutung der Schwerkraftanomalien in Niederländisch-Indien* (On the Interpretation of the Gravity Anomalies in Dutch-India) (van Bemmelen, 1935), both from the *Geologische Rundschau* (now

listed as the International Journal of Earth Sciences). Van Bemmelen continued to write extensively on theories in Techtonophysics, and on Indonesia (van Bemmelen, 1935, 1941, 1949b, 1953, 1963). He then wrote in English on the Origin and Mining of Bauxite in Netherlands-India (Van Bemmelen, 1941) and on the Report of Volcanic Activity and Vulcanological Research in Indonesia (1936-1948) (van Bemmelen, 1949b) in the *Bulletin of Volcanologique*. These works formed his most

5   significant contribution: *The Geology of Indonesia* (Van Bemmelen, 1949a; Van Bemmelen and Bourter, 1970). In addition, Rittman (1953) wrote specifically on the Magmatic Character and Tectonic Position of Indonesian Volcanoes. In terms of contributions by Indonesian researchers, John Ario Katili of the Bandung Institute of Technology (ITB), considered one the founding fathers of Indonesian Geology, wrote significant accounts on geotectonic knowledge of Indonesia from the period of 1963 to 1991 (Katili, 1975, 1991, 1974, 1967, 1971, 1989, 1969a, 1978, 1986, 1981b; 1963; 1969b, 1981a, 1980, 1973).

10   Other early and significant contributions come from Mudaham Taufick Zen and Djajadi Hadikusumo, from the Geological Survey of Indonesia, who collaboratively wrote some of the earliest and most important accounts on volcanoes in Indonesia (Zen and Hadikusumo, 1965, 1964b, a; 1971, 1970, 1966; 1974). It is also important to mention, though not indexed in Scopus, the work by Kusumadinata (1979), of the Geological Survey of Indonesia, on the *Catalogue of References on Indonesian Volcanoes with Eruptions in Historical Time*, amongst others (Kusumadinata, 1963, 1964a, b, c; cited in Rampino

15   and Self, 1982). The earliest accounts that explicitly examine DRR include Suryo and Clarke (1985) who wrote on the Occurrence and Mitigation of Volcanic Hazards in Indonesia, and laid out strategies such as the prediction of volcanic activity, hazard zoning and maps, and control of hazards through engineering structures. They wrote that ´*the main purpose of hazard maps is to assist the protection of people and their property near active volcanoes´* (Suryo and Clarke, 1985, p. 90). Verstappen (1994; 1993, p. 367) in his paper, the Volcanoes of Indonesia and Natural Disaster Reduction (with Some Examples), wrote

20   that ´*since emergency scenarios inevitably vary with intensity and type of land utilization, the compilation of vulnerability maps of the endangered areas merits consideration in the context of disaster reduction policy*'. An Indonesian notable scholar is Sudibyakto, from the Faculty of Geography, University of Gadjah Mada, and also the head of the Indonesia Disaster Scientist Association (IABI), who wrote Natural Disaster Mitigation and Management in Indonesia (Sudibyakto and Haroonah, 1997) and examine disaster from geographical and social science perspectives (Sudibyakto and Haroonah, 1997; 1992; 1996).

25   Some earliest publication were written in 1992 by Sudibyakto (1992) who wrote *Facts and Future Trends of Climate Change: A Case Study of the Eastern Part of the Indonesia Islands*, and by Murdiyarso (1993) who examined the management of climate change impacts to reduce CO_2 release resulting from deforestation and biomass in Indonesia.

The review finds that out of the 3,000 names obtained from the Scopus search, there are 68% of international authors compared to 32% Indonesian author. The contribution of international/non-Indonesian authors dominates the production of publications.

30   The figure shows that there are more authors, including Indonesian authors, in DRR category than the other two categories. There are slightly more papers with at least one Indonesian author than those with no Indonesian authors. A more striking examination of Indonesia authors shows that there are less than 100 authors with more than 2 publications. The majority of authors work for organizations that are located in Java where the high quality education providers are mostly located (OECD and ADB, 2015), dominated by male researchers and only a small minority of these researchers have social media account

such as Google Scholar (Google, 2016a) or Research Gate (2016b) or professional and personal websites. This implies that there is room for increasing the involvement of Indonesian authors writing about various issues related to DRR, and a greater opportunity for developing social science in DRR. More Indonesians need to be involved in international publications and specific interventions are needed to enhance writing, publication and outreach skills. Figure 5 summarizes the roles of Indonesian authors within each publication category (HRD, DRR, and CC).

Figure 5: Comparing the roles of international and Indonesian authors in each publication category

Table 3 compares the list of the top ten authors with highest number of publications and the Indonesian authors with the 10 highest publications. Highest in the list is Hasanuddin Zainal Abidin of the Bandung Institute of Technology (ITB), with 71 publications listed in Scopus, while his Google scholar profile shows that he has published 172, with 1709 citations (Google Scholar, 2016b). Franck Lavigne from *Université* Paris 1 Pantheon Sorbonne published the second highest numbers of papers (Google Scholar, 2016a). Lavigne worked closely with Jean-Claude Thouret from *Laboratory Magmas et Volcanis* (LMV, 2016). Danny Hilman Natawidjaja works for Indonesian Institute of Science (LIPI) (Google Scholar, 2016c) but did his bachelor study from Bandung Institute of Technology (ITB). Kerry Sieh, from Earth Observatory of Singapore (EOS), has long collaborated with Natawidjaja on their works on seismology in Indonesia (EOS, 2016). Barry Voight is a renowned geologist and volcanologist in USA who has worked on the Mount Merapi since the 1980s (Google Scholar, 2016e). Ralf Gertisser is a senior lecturer in Keele University (Google Scholar, 2016d). Bambang Widoyoko Suwargadi is affiliated with LIPI and Surono (1 name only) and Muhammad Hendrasto both work for the Center for Volcanology and Geological Hazard Mitigation (PVMBG, 2016). In addition to the 5 Indonesians in the top 10 authors, Irwan Meilano, Heri Andreas and Irwan Gumilar have worked closely with Hasanuddin Zainal Abidin and are all affiliated with ITB. Muh. Aris Marfai and Junun Sartohadi are from the Gadjah Mada University (UGM). This result shows a great deal of need for increasing the capacity of Indonesian authors meet standards for internationally regarded journal publications. There are a limited number of authors involved with publications in the highest impact factor (IF) journals such as Nature and Science. Indonesian authors largely lack experience in international collaboration and the language and writing skills necessary for submitting their works to internationally accredited journals: High impact articles and collaborations were only done through organizations centred on ITB, UGM, LIPI and PVMBG. Despite some Indonesian researchers who have been strongly influential within the study of hazards, DRR or climate change in Indonesia and could potentially contribute to the global development of knowledge in these fields, they have only published in Bahasa Indonesia and did not submit their works into international mostly English language journals.

Table 3: List of Top Ten Authors with Highest Number of Publications, and Top Ten Indonesian Authors (SCOPUS, 2016a; Google, 2016b; Research Gate, 2016a)

3.2.2 Affiliations

This section systematically examines the place, from regional to national, and organizations by which the researchers are affiliated in Indonesia. The organizations which house the ten most productive publications related to this review are shown

in Figure 6. In general, there are an equal number of organizations that are based in Indonesia, and their contributions comprised slightly more than half the overall contributions amongst these most productive agencies. This paper looks deeper at the contribution of different organizations within Indonesia. It is shown that ITB and UGM dominate almost half the total publications. There are also more twice universities in Java that those outside Java, while the rest of publications are contributed by national level organizations such as LIPI and PVMBG.

Figure 6: Organizations with Highest Number of Publications (Indonesian Organizations marked with *)

3.2.3 Publications Sources

This section presents the source of publications. Most of publications that got indexed are those from journals, compared to conference proceedings, books, or others. A closer look at the journals shows those related to geophysical hazards (volcanoes, earthquakes, tsunami) identification and assessments dominate the numbers of papers published on Indonesia (Table 4). Moreover, the Indonesian Journal of Geography is the only Indonesian journal that is found this review. The journal was established in 1961 by the Faculty of Geography, UGM in cooperation with the Association of Indonesian Geographers (UGM, 2016). There are no clear counts on the number of academic journals in Indonesia, however, there are only 245 accredited by DIKTI (Higher education directorates of the Ministry of Education) (DIKTI, 2016b) and 17 indexed in SCOPUS (DIKTI, 2016a). In addition, none of these journals have yet obtained an impact factor, and hence a Scientific Journal Ranking (SJR) Score is presented instead (SJR, 2016).

Table 4: List of Most Submitted Journals

3.2.4 Citations

This section analyzes the citations for each topic category. Overall, the HRD category has the highest number of citations, in total more than two thirds (3945/5291) of all citations. A look of the citation averages, however, shows quite a different story. Whilst the CC literature category has the least number of papers published (194), the citation average is twice of the DRR category (3,18). Figure 7 shows the comparison between the progress of Indonesian researchers in the 10 most cited papers overall and those first authored by Indonesians. The role of first author has been considered significant since they are traditionally assumed to lead the research and write most of the content, and therefore receive most credit (Riesenberg and Lundberg, 1990; Hu, 2009). It shows that there are more authors, mostly international authors in the 10 most cited papers, while there are more Indonesians in the 10 most cited papers first authored by Indonesians. This might suggest that Indonesian researchers tend to work with other Indonesians and hence needed to expand their collaborations with international scholars as a strategy to increase their number of citations and ability to submit for higher impact journals.

Figure 7: Comparing the Roles of Indonesian Researchers in the 10 Most Cited Papers

Table 5 shows the list of the 10 most cited papers of all publications. Within the 10 most cited papers, the total citations are 4,204 with a combined impact factor (IF) of 293.618, and only one third of the authors are Indonesian. The citation is three times of those first authored by Indonesians, and the IF is 4 times greater. It is shown that they are published in high impact

factor journals such as Nature, Science, or those related to geophysical hazards. The two highest cited papers are published in Nature and discuss the impacts of forest fires in Indonesia. The paper related to the examination of the amount of carbon released from peat and forest fires in Indonesia in 1997 has the highest citation of 1287 by Page et al (2002). The majority of the papers discuss major hazards from the earthquake in Sumatera (Ishii et al., 2005; Briggs et al., 2006; Hsu et al., 2006;

5 Konca et al., 2008), to the impacts of Toba (Rampino and Self, 1992) and Merapi volcanic eruptions (Voight et al., 2000). Eight papers were also contributed by Indonesians with Natawidjaja was involved in five of them. Adi Jaya and Suwido Limin are both lecturers from the Palangkaraya University in Kalimantan, where forest fires frequently occurred across the rain forest and impacted not only Indonesia but also surrounding countries in the region such as Singapore (Tay, 1998) and Malaysia (Khandekar et al., 2000). Natawidjaja and Subarya, along with Sieh contributed the most (Briggs et al., 2006; Hill et al., 2012;

10 Horspool et al., 2014; Hsu et al., 2006; Konca et al., 2008; Muhari et al., 2010; Nalbant et al., 2005; Philibosian et al., 2012; Prayoedhie et al., 2012; Schlurmann et al., 2010; Singh et al., 2010).

A closer examination of the list of ten most cited publications with Indonesian first authors shows a very striking picture. The total citations are only 1542, with a combined IF of only 70, 012, with 80% of all authors being Indonesian. The papers are much more varied in terms of topics they discussed. The first two most cited papers are related to impacts of climate change

15 in Indonesia. Aldrian (2003), Susanto (2003; 2001) and also Amien et al (1996) authored papers related to climate change or its impacts on Indonesia. Natawidjaja (Natawidjaja et al., 2006; Natawidjaja et al., 2004) and Abidin (Abidin et al., 2001; Abidin et al., 2011) both have 2 papers to contribute each within the list of most cited papers first authored by Indonesian on earthquakes and land subsidence assessments. One paper examines the impacts of volcanoes (Andreastuti et al., 2000). Marfai wrote extensively on coastal risks and disasters in cities such as Semarang or Jakarta (Marfai and King, 2008; Marfai et al.,

20 2008; Marfai et al., 2015; Ward et al., 2013; Marfai, 2014; Marfai and King, 2007). This table shows that in general, Indonesian authors still write papers with fewer citations, and the organizations that house these authors are still extremely limited to ITB, UGM, LIPI, and PVMBG. Another significant finding here is that there is no paper on DRR. This is an important finding that which also show how social science perspectives needed to be taken up by the Indonesia researchers in dealing with the management of disaster risks and disaster risks in Indonesia.

25 **Table 5: Comparing Citations Authored in General and Those First Authored by Indonesian in 10 Most Cited Papers**

4 Recommendations for Future Research and Policy Relevance, and Conclusions

This paper has presented the results of an SLR from Scopus to on the current research trends and progress related to natural hazards, disasters, and disaster risks reduction, as well as increasingly climate change impacts and governance in Indonesia. The paper also examines the roles of Indonesian authors and organizations in contributing to publications related to these

30 topics. We have seen that some of the earliest publications were written in 1934 and publications started to increase rapidly since 2000. It is found there are more publications on HRD, than those on DRR and CC. Moreover, there are twice international authors for every Indonesian author and the contribution of international authors dominates the production of publications.

Most of the high impact publications and international collaborations were conducted with the key institutions centred on ITB, UGM, LIPI and PVMBG. Male and advanced career authors still dominate, compare to the numbers and roles of female and early career researchers (ECR). In addition, there are very few researchers have social media accounts such as Google Scholar (Google, 2016a) or Research Gate (Research Gate, 2016b) or professional and personal websites.

5 The *first* recommendation is related to future research topics. More research is needed on different hazards, different locations in Indonesia, and other topics in DRR and climate change. Majority of current research is still focused on geophysical hazards and those related to hydro-meteorological hazards have only received attention recently. It has been seen that majority of research focuses on the Islands of Java and Sumatera. This is expected since both islands are the most at risks from natural hazards in Indonesia. Multi hazard, risks and vulnerability assessments are suggested. Research and actions that focus on the

10 most vulnerable places and communities are needed. As the world is increasingly urbanized, there is strong international attention focusing and reducing risks in urban areas, in particular through concerted action in the New Urban Agenda (UN HABITAT, 2016). More research need to consider the context of urban areas by which social risks and risks from natural hazards play out simultaneously, and the impacts on urban dwellers needs to be understood. Cities in Indonesia like Jakarta, Surabaya or Makassar are rapidly urbanizing and environmental and economic pressures increase risks for the inhabitants

15 (Firman et al., 2011; Larson et al., 2013; Santosa, 2000; Firman, 2016; van Voorst, 2016).

Strategies and actions for integrating DRR and CCA need to be explored further (Djalante and Thomalla, 2012; Lassa and Nugraha, 2015). Disaster risk governance has not received much research especially on the interplay with decentralization which places responsibility for DRR and CCA at the local government level (Lassa, 2013; Kusumasari et al., 2010). The strategies outlined are not only relevant for research but also for the governance for climate change. The islands in Kalimantan,

20 Sulawesi, Maluku and Papua in the eastern part of Indonesia have also been impacted by droughts, floods or strong winds and needs to be addressed in the future. The impacts of sea level rise on small islands, drought on forests in Kalimantan and Papua, raising sea level and ocean acidification on fisheries industry in Sulawesi and eastern part of Indonesia, are some of the increasingly worrisome issues expected from climate change. There is still greater need for research and government actions on climate change topics related to linkages between poverty and disaster vulnerability (Suryahadi and Sumarto, 2003),

25 security (CSIS, 2016), loss and damages (Warner et al., 2012), impacts on key sectors such as fisheries (USAID Indonesia, 2015), coastal communities (Marfai, 2014; Marfai et al., 2008), food security (Measey, 2012; WFP, 2015) health (Ady Wirawan, 2010; Haryanto, 2009), migrations (Raleigh et al., 2008; Reuveny, 2007), and community-based DRR (Heijmans, 2012). Many activities done by the Indonesian government and international and development agencies on their implementations for DRR or CCA programmes have focused at different administrative level from national, regional, local

30 and on the community level. There is abundance of activity reports by governments, donor and international agencies (e.g. USAID, 2016; USAID Indonesia, 2011, 2015); however, those reports are rarely made available or submitted for academic publications.

The *second* recommendation is on the need to strengthen the capacity of research collaborations between Indonesian and international researchers, multi-disciplinary research and publications in high impacts journals, along with the need for

strengthening of science communication to social media outlets and science-policy advocacy. There needs to be more funding and incentives for collaborations. More trainings on English academic writing and journal article publications are needed, including capacity building for early career, female and social science researchers. It is clear that some of the very limited Indonesian research from key universities doing disaster research such as ITB, LIPI, UGM have been involved in international

5   collaborations and publications of high impacts journal (QS, 2016). There are only nine universities in Indonesia that are within the list of QS World University Rankings, with University of Indonesia at the top of the list (QS, 2016). Other universities on the islands of Sumatra, Sulawesi, and Kalimantan and other locations need to address disaster issues as part of their research agendas (OECD and ADB, 2015). There is a need for better targeting of scholars to do more collaboration for research and writing for high impact journals. This goes along with strengthening the capacity of researchers and lecturers at

10   the universities to write and publish in international journals. The Ministry of Education has indeed conducted a training scheme and provided incentives for lecturers that have published internationally (RISTEKDIKTI, 2016), however, the overall quality and quantity of papers by Indonesian researchers are still much less that those at comparable universities in Malaysia or Singapore (RISTEKDIKTI, 2016). The list from Scopus shows that there is still only small numbers of female and early career researchers (SCOPUS, 2016a). There needs to be a proper identification of researchers and make this available to public.

15   The author could not find a repository of researchers from the Ministry of Education website, let alone systematically determining their progress, history of schooling and research. There have been some concerns to strengthen the capacity of female researchers globally (Larivière et al., 2013), and also similarly in Indonesia. Early career researchers (ECR) are defined as those who are within 8 years after completing PhDs or within 6 years of trainings (AHRC, 2016). While globally there has been some systematic efforts to strengthen the capacity of ECR such as through mentoring (Clarke, 2004; Kram and Isabella,

20   1985), there are no clear strategies for the Indonesian ERC from the Indonesian governments. International journals (Elsevier, 2016) and international and other national research council (RCUK, 2016) have allocated resources and are funding research specifically for ECR. The Indonesian Association of Disaster Experts was formed in 2014 and meets annually to discuss their future research guidelines (IABI, 2016). One thing that should be on the agenda is to review current publications in Bahasa Indonesia and collaborations undertaken by Indonesian experts which can enable better identification of research progress and

25   hence research needs in the future. There is abundance of materials within Indonesian repositories related to *bencana* (Indonesia word for disaster), especially within the repositories at ITB, UGM, and University of Syiah Kuala in Aceh. These materials and research activities done within the universities need to be reviewed and submitted for international journals to give a broader view on issues that have been discussed by scholars in Indonesia. There is increasing call for more inter-disciplinary collaborations so that complex problems on social and environmental issues can be understood better and problems

30   identifications can better target those in needs (Future Earth, 2016). Hence this implies increasing importance of social science adoption to study disasters and their impacts. The roles of private business and the communities at risk have rarely been part of the research and collaborations. It is also not clear how collaborations amongst scientists from social and physical backgrounds have taken place in Indonesia. It is also not clear how or whether science (Wagner and Leydesdorff, 2005a), policy and industry (Lee, 1996) collaborations have taken place and were documented in these listed publications. These

collaborations are important to face the complexities of future problems (Leydesdorff and Wagner, 2008), and also to help achieve the outcomes of the Sustainable Development Goals (United Nations, 2015).

In conclusion this study has been able to determine the progress in research related to natural hazards, risks, and risk reduction and climate change impacts in Indonesia. It has also been able to examine the roles of Indonesian scientists in collaborations

5 and towards high-quality publications. The recommendations are outlined toward these two issues and it is the responsibility of both Indonesian and international organizations including governments that have worked and will work in Indonesia to be able to meet the needs for Indonesia to better understand, manage, and reduce its natural hazards and risks in the future and ultimately build a resilient and sustainable Indonesia.

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Table 1: Multi-Stage Processes for Inclusion and Exclusions for Search Terms.

Stage	Inclusion / Exclusion	Description	Search terms	Results
First	Inclusion based on Search Terms	Keywords	(TITLE-ABS-KEY(hazard*) OR TITLE-ABS-KEY(risk*) OR TITLE-ABS-KEY(disaster*) OR TITLE-ABS-KEY(disaster management*) OR TITLE-ABS-KEY(disaster risk reduction*) OR TITLE-ABS-KEY(climate change*) OR TITLE-ABS-KEY(climate change adaptation*) OR TITLE-ABS-KEY(resilien*) OR TITLE-ABS-KEY(vulnerabili*) OR TITLE-ABS-KEY(volcan*) OR TITLE-ABS-KEY(geolog*) AND TITLE-ABS-KEY(Indonesia)).	8077
Second	Exclusion on keywords	Those that are relate to clinical/health studies		3447
	Exclusion on subject area	Only those in environmental studies in general		
	Exclusion on title	Tittles are deemed unrelated		
	Exclusion on language	Those that are not written in English and Bahasa Indonesia are excluded	AND (EXCLUDE (LANGUAGE , "Italian") OR EXCLUDE (LANGUAGE , "Polish") OR EXCLUDE (LANGUAGE , "Spanish") OR EXCLUDE (LANGUAGE , "Afrikaans") OR EXCLUDE (LANGUAGE , "Swedish"))	
	Exclusion on subject area	Those that are too broad on the subject area are excluded	AND (EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "BUSI") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "PSYC") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "HEAL"))	
	Exclusion on document type	Only journal articles are included	AND (EXCLUDE (SRCTYPE , "d") OR EXCLUDE (SRCTYPE , "r")) AND (EXCLUDE (DOCTYPE , "cr") OR EXCLUDE (DOCTYPE , "no") OR EXCLUDE (DOCTYPE , "sh") OR EXCLUDE (DOCTYPE , "ed"))	
Final	Transfer Exclusion	Those that are too broad on the subject area are excluded	Transfer to XML and excel Form. Topics that are too broad, e.g. mining, general climate science, minor mention or not directly on Indonesia	921

Table 2: Major Research Topics, Descriptions and Numbers of Publications

Major topics groups	Definitions (IPCC, 2012; UNISDR, 2009)	Number of publications (Percentage)
(1) Natural hazard, risks, disasters assessments (HRD)	Hazards: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR). Risks: The combination of the probability of an event and its negative consequences. Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR).	517 (56%)
(2) Disaster risk management or reduction (DRR)	The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster (UNISDR). The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR).	210 (23%)
(3) Climate change vulnerability, impacts and adaptation (CC)	Climate Change: A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (IPCC). Climate change adaptation: The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (UNISDR).	194 (21%)
Total		921 (100%)

Table 3: List of Top Ten Authors with Highest Number of Publications, and Top Ten Indonesian Authors (SCOPUS, 2016a; Google, 2016b; Research Gate, 2016a).

5   Note: NoP =Number of Publications, SC= SCOPUS Profile (publications, citations, h-index, number of co-authors, most frequent collaborator), GS = Google Scholar profile (citations, h-index, i10-index), RG = Research Gate profile (number of publications, citations, impact points), N/A = Not Available

Top 10 Author (I=Indonesian)	Organization / Country	NoP	SC	GS	RG	Top 10 Indonesian Author	Organization	NoP	SC	GS	RG
Abidin, HZ (I)	Indonesia / Institute Teknologi Bandung (ITB)	71	71, 571, 11, 150, Andreas, H	172, 1709, 41	119, 773, 99.21	Abidin, HZ	ITB	71	71, 493, 11, 121, Andreas H	N/A	119, 773, 99.21
Lavigne, F	France / Université Paris 1 Panthéon Sorbonne	59	66, 1356, 20, >150, Wassmer, P	124, 1648, 34	153, 1430, 162.61	Meilano, Irwan	ITB	47	46, 299, 10, 143, Kimata, F	514, 11, 14	24, 69,

Top 10 Author (I=Indonesian)	Organization / Country	NoP	SC	GS	RG	Top 10 Indonesian Author	Organization	NoP	SC	GS	RG
Sieh, K	Singapore / Earth Observatory of Singapore	54	120, 5752, 43, >150, Natawidjaja, DH	N/A	N/A	Natawidjaja, DH	(Indonesian Institute of Science) LIPI	43	43, 1913, 21, 123, Sieh KE	147, 2964, 25, 123, 33	123, 2788, 376.31
Natawidjaja, DH (I)	Indonesia / LIPI	43	42, 1913, 21, 123, Sieh KE	147, 2964, 25, 33	123, 2788, 376.31	Suwargadi, BW (I)	Indonesia / LIPI	31	31, 1102, 17, 103, Natawidjaja, DH	97, 1585, 20, 24	N/A
Thouret, J-C	France / Laboratory Magmas er Volcanis	40	114, 1147, 20, >150, Gourgaud, A	N/A	N/A	Surono (1 name only)	(Center for Volcanology and Geological Hazard Mitigation) PVMBG	28	28, 348, 12, 125, Hendrasto M	N/A	N/A
Voight, B	USA / Pennsylvania State University	36	313, 8185, 53, 128	2505, 307 570, 75		Andreas, H	ITB	24	24, 123, 6, 46, Abidin, H Z	N/A	N/A
Gertisser, R	United Kingdom / Keele University	32	42, 684, 468, 14, >150, Charbonnier SJ	86, 1009, 19, 29	87 803 132, 51	Marfai, MA	Gadjah Mada University (UGM)	21	183, 8, 36, King, L	79, 517, 12, 14	N/A
Suwargadi, BW (I)	Indonesia / LIPI	31	31, 1102, 17, 103, Natawidjaja, DH	97, 1585, 20, 24	N/A	Gumilar, I	ITB	20	20, 68, 3, 44, Abidin HZ	N/A	N/A
Surono (I)	Indonesia / PVMBG	28	28, 448, 13, 129, Hendrasto M	N/A	N/A	Sartohadi, J	UGM	19	19, 378, 8, Lavigne, F	N/A	N/A
Andreas, H (I)	ITB	24	123, 6, 46, Abidin, H Z	N/A	N/A	Hendrasto M	PVMBG	18	18, 92, 4, Surono	N/A	N/A
Total		416						306			

Table 4: List of Most Submitted Journals.

Publications	Number of papers	IF / SJR	Category		
			HRD	DRR	CC
1. Journal of Volcanology and Geothermal Research	75	2.543	x		
2. Natural Hazards	39	1.719	x	x	
3. Natural Hazards and Earth System Science	27	1.735	x	x	
4. Bulletin of Volcanology	22	2.519	x		
5. Geophysical Research Letters	17	4.196	x		

#	Journal				
6.	Earth and Planetary Science Letters	16	4.734	x	
7.	Pure and Applied Geophysics	15	1.618	x	
8.	Nature	14	41.456	x	x
9.	Journal of Disaster Research	14	SJR 0.18	x	
10.	Journal of Geophysical Research: Solid Earth	12	3.426	x	
11.	International Journal of Disaster Risk Reduction	12	SJR 0.510	x	x
12.	Bulletin of the International Institute of Seismology and Earthquake Engineering	12	SJR 0.12	x	

Table 5: Comparing Citations Authored in General and Those First Authored by Indonesian In 10 Most Cited Papers

Note: Y=Year, J=Journal, C=Number of Citations, IF=Journal impact factors, I=Indonesia author (marked at the authors column)

Overall							First authored by Indonesian					
Authors (Indonesian are marked I)	Title	Y	J	C	IF		Authors (Indonesian are marked I)	Title	Y	J	C	IF
Page S.E., Siegert F., Rieley J.O., Boehm H.-D.V., Jaya A., (I) Limin S. (I)	The amount of carbon released from peat and forest fires in Indonesia during 1997	2002	Nature	1280	41.456		Aldrian E. (I), Susanto RD (I)	Identification of three dominant rainfall regions within Indonesia and their relationship to sea surface temperature	2003	International Journal of Climatology	344	3.609
Siegert F., Ruecker G., Hinrichs A., Hoffmann A.A.	Increased damage from fires in logged forests during droughts caused by El Niño	2001	Nature	519	41.456		Subarya, C (I), Chlieh, M, Prawirodirdjo, L (I), Avouac, JP, Bock, Sieh, Meltzner, Natawidjaja (I), McCaffrey	Plate-boundary deformation associated with the great Sumatra-Andaman earthquake	2006	Nature	343	41.456
Ishii M., Shearer P.M., Houston H., Vidale J.E.	Extent, duration and speed of the 2004 Sumatra-Andaman earthquake imaged by the Hi-Net array	2005	Nature	386	41.456		Susanto RD. (I), Gordon A.L., Zheng Q.	Upwelling along the coasts of Java and Sumatra and its relation to ENSO	2001	Geophysical Research Letters	161	4.196
Aldrian E. (I), Dwi Susanto R. (I)	Identification of three dominant rainfall regions within Indonesia and their relationship to sea surface temperature	2003	International Journal of Climatology	343	3.157		Natawidjaja, DH (I), Sieh, K., Chlieh, M.,, Galetzka, J.,, Suwargadi, BW., (I), Cheng, H., Edwards, RL., Avouac, JP., Ward, SN	Source parameters of the great Sumatran megathrust earthquakes of 1797 and 1833 inferred from coral microatolls	2006	Journal of Geophysical Research: Solid Earth	156	3.318
Subarya, C (I), Chlieh, M, Prawirodirdjo, L (I), Avouac, JP, Bock, Sieh, Meltzner,	Plate-boundary deformation associated with the great Sumatra-Andaman earthquake	2006	Nature	343	41.456		Danny Hilman Natawidjaja (I), Kerry Sieh, Steven N Ward, Hai Cheng, R Lawrence Edwards,	Paleogeodetic records of seismic and aseismic subduction from central Sumatran microatolls, Indonesia	2004	Journal of Geophysical Research: Solid Earth	119	3.318

Overall

Authors (Indonesian are marked I)	Title	Y	J	C	IF
Natawidjaja (I), McCaffrey					
Rampino MR., Self S.	Volcanic winter and accelerated glaciations following the Toba super-eruption	1992	Nature	333	41.456
Sieh, Natawidjaja (I)	Neotectonics of the Sumatran fault, Indonesia	2000	Journal of Geophysical Research: Solid Earth	317	3.426
C Vigny, WJF Simons, S Abu, R Bamphenyu, C Satirapod, N Choosakul, C Subarya, A Socquet, K Omar, HZ Abidin, BAC Ambrosius	Insight into the 2004 Sumatra–Andaman earthquake from GPS measurements in southeast Asia	2005	Nature	329	41.456
Hsu Y.-J., Simons M., Avouac J.-P., Galeteka J., Sieh K., Chlieh M., Natawidjaja D. (I), Prawirodirdjo L. (I), Bock Y.	Frictional afterslip following the 2005 Nias-Simeulue earthquake, Sumatra	2006	Science	271	33.61
Briggs R.W., Sieh K., Meltzner A.J., Natawidjaja D. (I), Galetzka J., Suwargadi B. (I), Hsu Y.-J., Simons M., Hananto N. (I), Suprihanto I. (I), Prayudi D. (I), Avouac J.-P., Prawirodirdjo L. (I), Bock Y.	Deformation and slip along the Sunda megathrust in the great 2005 Nias-Simeulue earthquake	2006	Science	226	33.61

First authored by Indonesian

Authors (Indonesian are marked I)	Title	Y	J	C	IF
John Galetzka, Bambang W Suwargadi (I)					
Abidin HZ, Djaja, R, Darmawan D, Hadi. S, Akbar, S, Rajiyowiryono, Sudibyo, Y, Meilano, I, Kasuma, MA, Kahar, J, Subarya, C (All I)	Land subsidence of Jakarta (Indonesia) and its geodetic monitoring system	2001	Natural Hazards	103	1.719
Andreastuti S.D. (I), Alloway B.V., Smith I.E.M.	A detailed tephrostratigraphic framework at Merapi Volcano, Central Java, Indonesia: Implications for eruption predictions and hazard assessment	2000	Journal of Volcanology and Geothermal Research	81	2.543
Marfai, M. A. (I), King, L	Monitoring land subsidence in Semarang, Indonesia	2007	Environmental Geology Journal of Geophysical Research: Solid Earth	68	3.318
Marfai, M. A. (I), King, L	Potential vulnerability implications of coastal inundation due to sea level rise for the coastal zone of Semarang city, Indonesia	2008	Environmental Geology Journal of Geophysical Research: Solid Earth	59	3.318
Marfai MA (I), Almohammad H, Sudip Dey, Susanto, B (I), King, L	Coastal dynamic and shoreline mapping: multi-sources spatial data analysis in Semarang Indonesia	2008	Environmental Monitoring and Assessment	57	1.663

Overall							First authored by Indonesian					
Authors (Indonesian are marked I)	Title	Y	J	C	IF		Authors (Indonesian are marked I)	Title	Y	J	C	IF
Konca A.O., Avouac J.-P., Sladen A., Meltzner A.J., Sieh K., Fang P., Li Z., Galetzka J., Genrich J., Chlieh M., Natawidjaja DH. (I), Bock Y., Fielding E.J., Ji C., Helmberger D.V.	Partial rupture of a locked patch of the Sumatra megathrust during the 2007 earthquake sequence	2008	Nature	207	41.456		Amien I. (I), Rejekiningrum P. (I), Pramudia A. (I), Susanti E (I).	Effects of interannual climate variability and climate change on rice yield in Java, Indonesia	1996	Water, Air, and Soil Pollution	51	1.554
Total				**4547**	**296,775**						**1542**	**70,012**

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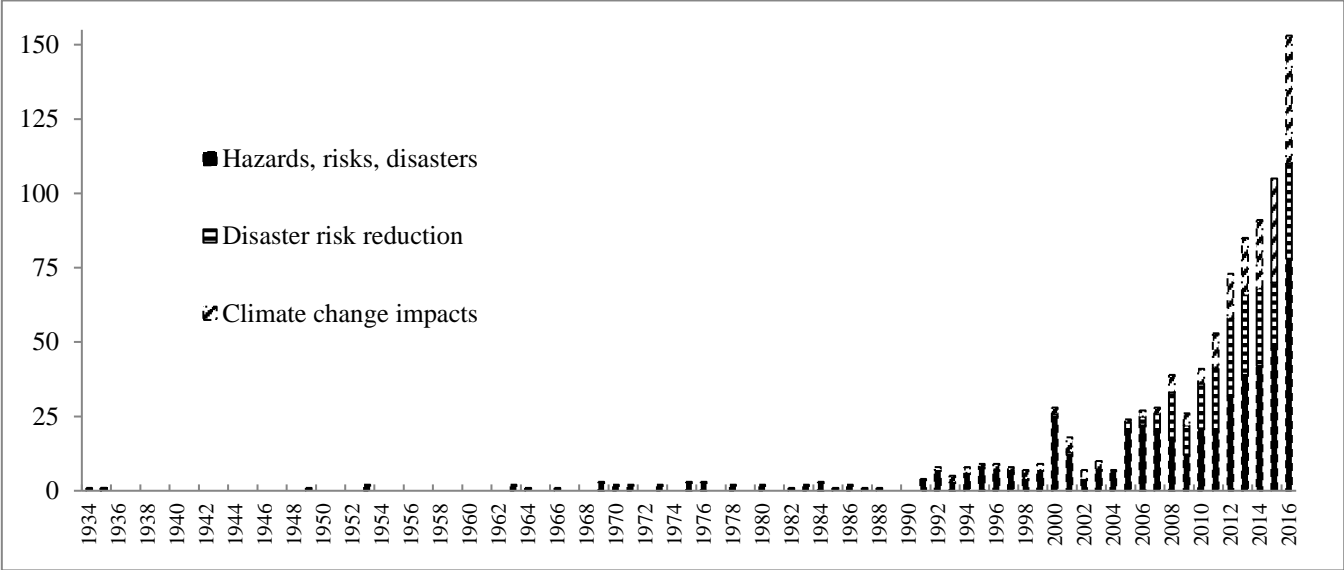
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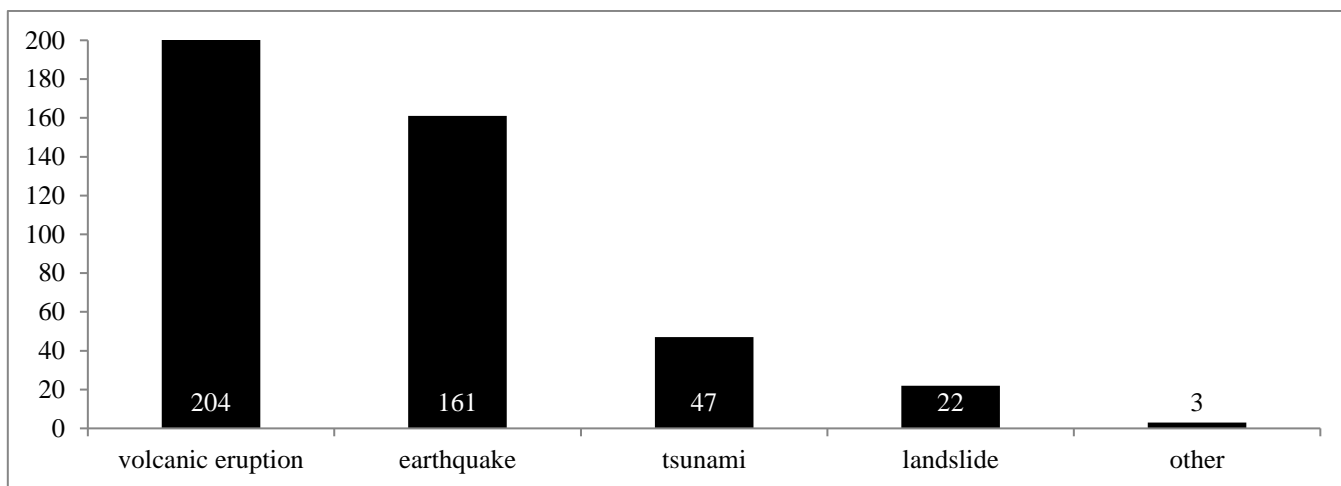
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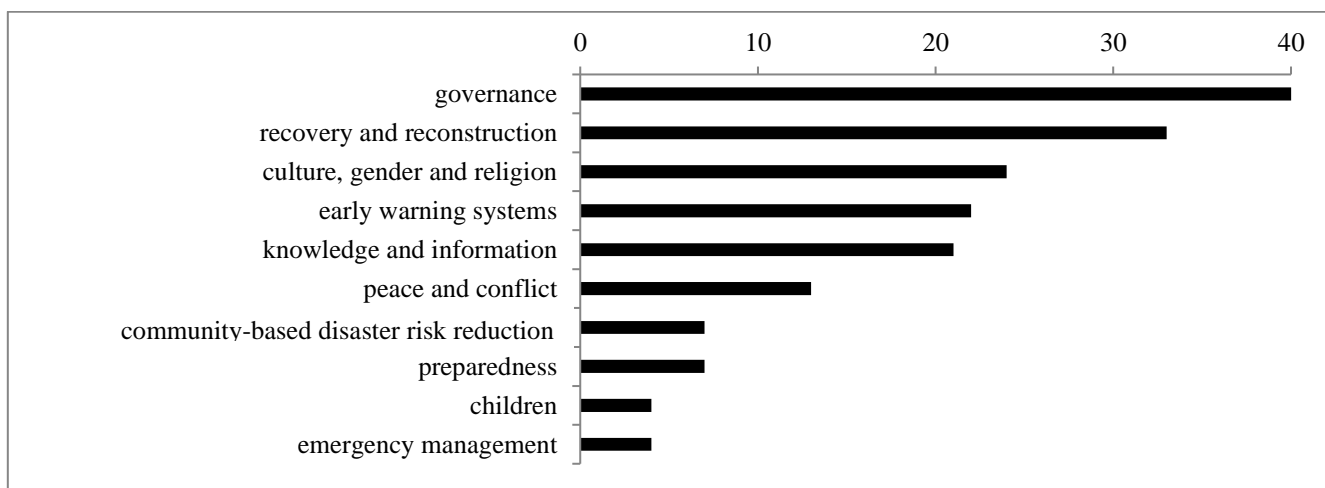
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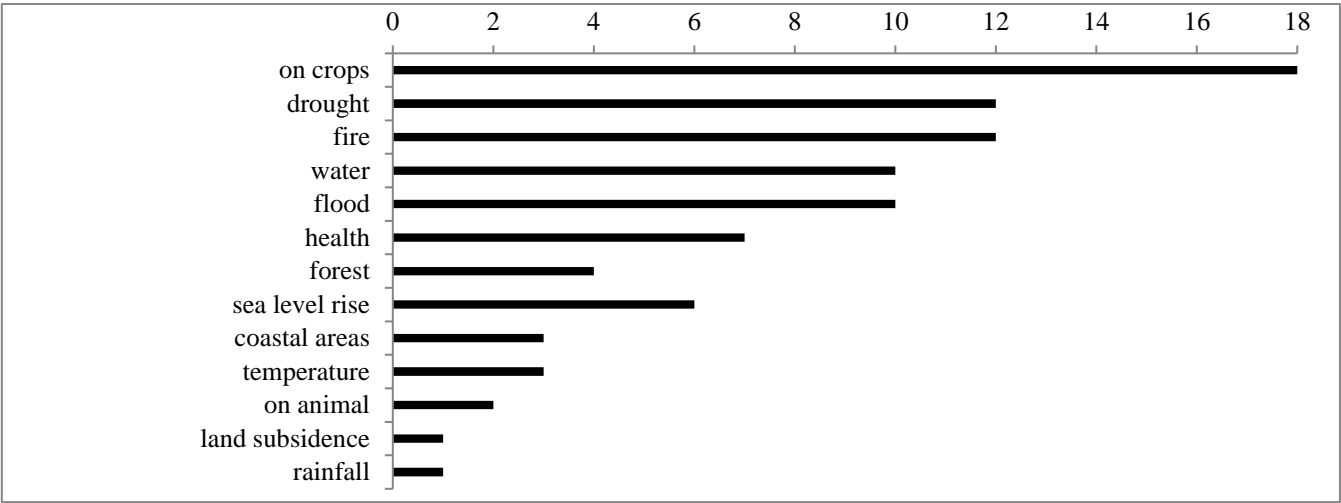
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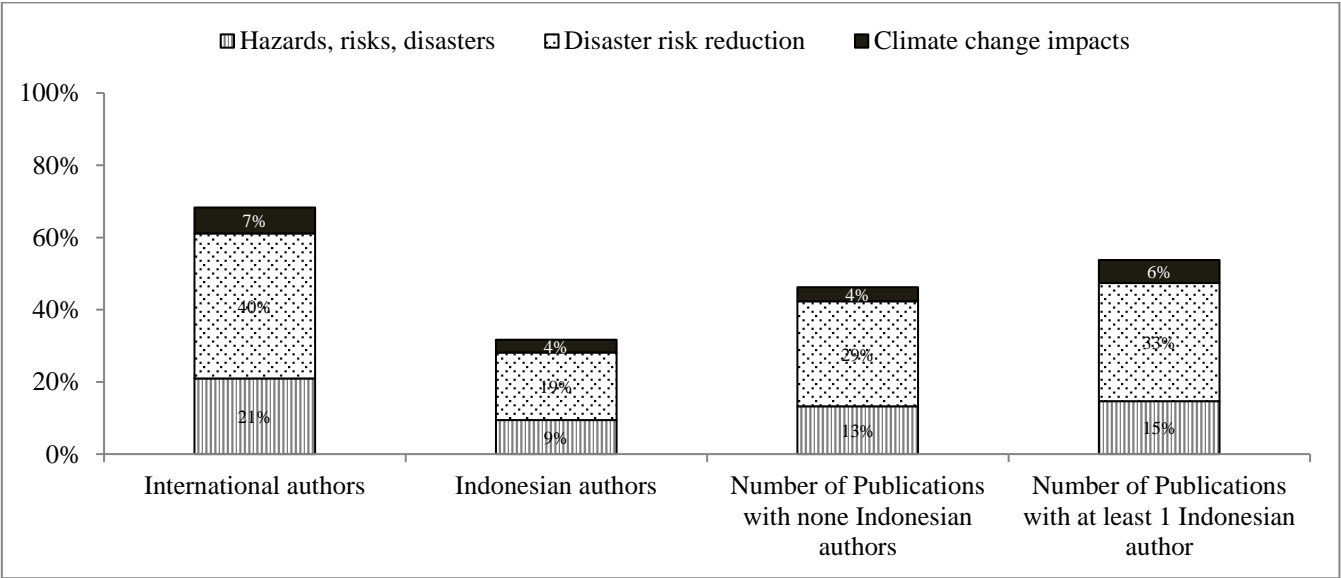
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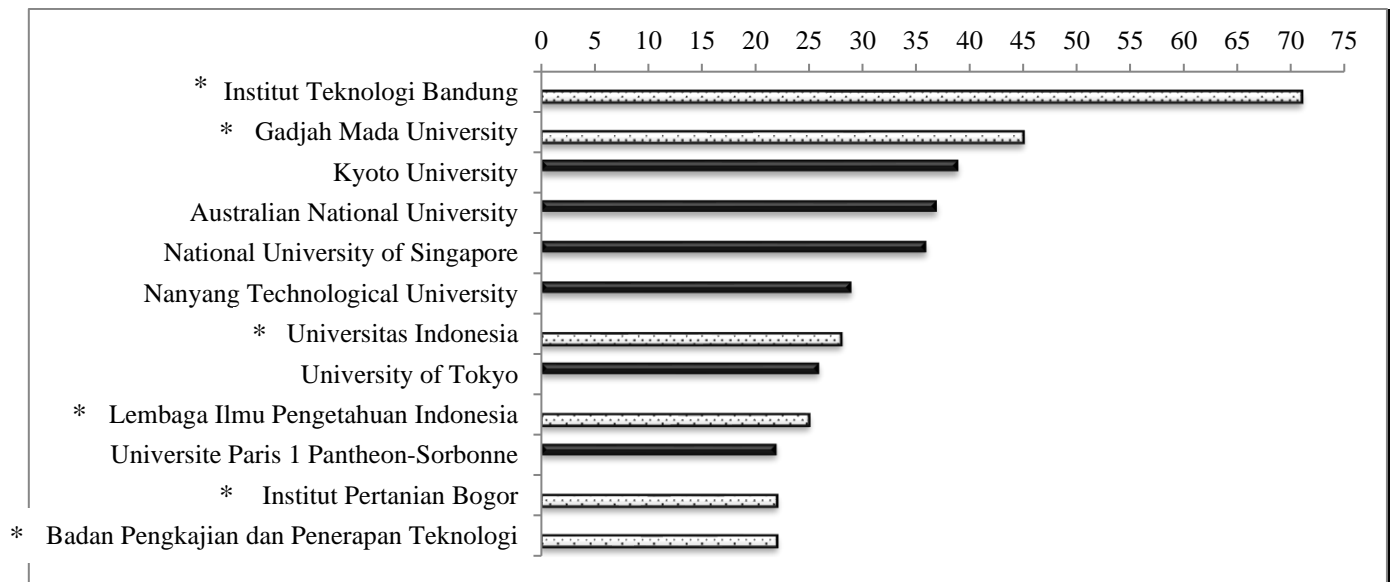
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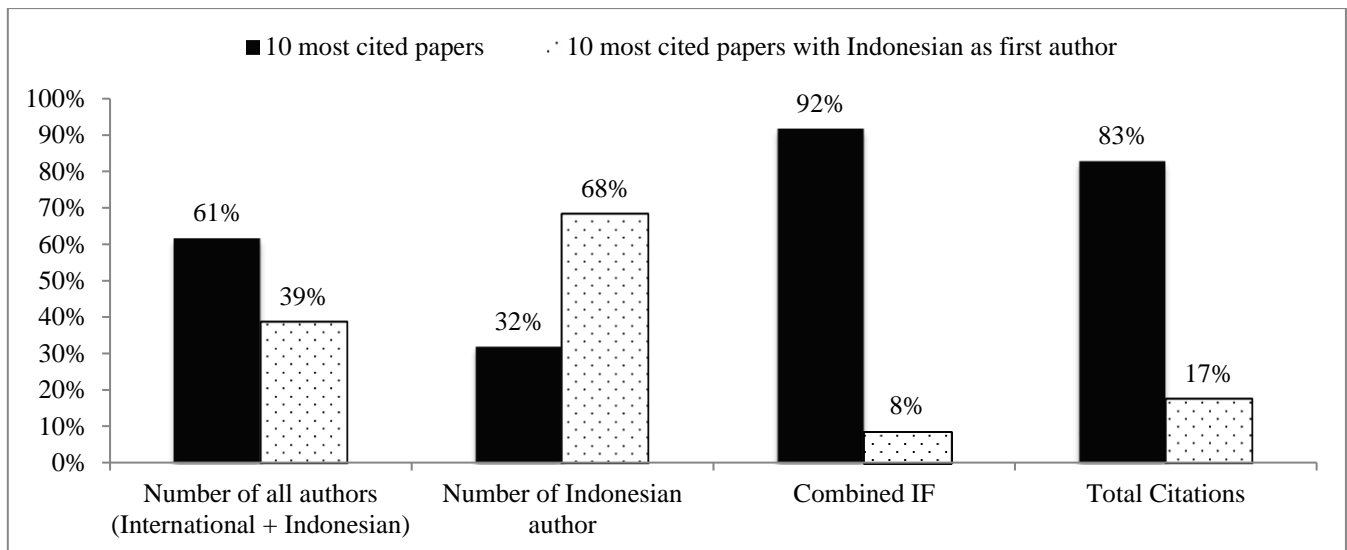
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