

**Population, Migration and Climate Change*****Populasi, Migrasi dan Perubahan Iklim***Ekawati S Wahyuni<sup>1,\*</sup>, Sri Hartini Rachmad<sup>2</sup>, Dina Nurdinawati<sup>1</sup><sup>1</sup> Department of Communication and Community Development Sciences, IPB University, Bogor 16680, Indonesia<sup>2</sup> BPS – Statistics Indonesia, Jakarta 10710, Indonesia\*) Corresponding author: [ewahyuni@apps.ipb.ac.id](mailto:ewahyuni@apps.ipb.ac.id)**ABSTRACT**

The objective of this research is to explain how climate change affects and is affected by population growth and migration. The global analysis will then be followed by a specific study in Indonesia on the relation between population migration and natural disaster events. The research method used a secondary data analysis based on literature review, the 2015 Inter-Census Population Survey (SUPAS) data and 2013 disaster data. To reduce greenhouse gas emissions and ensure the sustainability of the planet's earth, there are three things that should be done, namely to reduce the pace of population growth, to change the pattern of consumption of natural resources, and to increase Earth's carrying capacity by using technologies and innovations. Migration is mostly caused by economic needs, while migration due to disaster events is very small. Migration data records permanent migration type, while the disaster-affected population usually migrates on the temporary bases. The BPS-Statistics Indonesia and the National Disaster Management Authority should have some agreement on defining disasters, including climate change induced-disasters, and on how to collect and store data on the number of people impacted by each of them.

**Keywords:** Climate Change, Migration, Population**ABSTRAK**

*Tujuan penelitian adalah untuk menjelaskan bagaimana perubahan iklim mempengaruhi dan dipengaruhi oleh pertumbuhan penduduk dan migrasi, analisis global akan diikuti oleh kajian khusus tentang migrasi penduduk dan peristiwa bencana di Indonesia. Penelitian menggunakan metode analisis sekunder dalam bentuk tinjauan pustaka, dan analisis data sekunder dengan menggunakan data SUPAS 2015 dan data bencana 2013. Untuk mengurangi emisi gas rumah kaca dan memastikan keberlanjutan planet bumi ada 3 hal harus dilakukan, yaitu mengurangi kecepatan pertumbuhan penduduk, mengubah pola konsumsi sumber daya alam, dan meningkatkan daya dukung Bumi dengan teknologi dan inovasi. Migrasi utamanya disebabkan oleh kebutuhan ekonomi dan sangat sedikit yang disebabkan peristiwa bencana. Data migrasi yang tersedia mencatat tipe migrasi permanen, sedangkan penduduk yang terkena dampak bencana umumnya bermigrasi secara temporer. BPS dan BNPB harus bersepakat dalam mendefinisikan bencana, termasuk yang disebabkan oleh perubahan iklim, dan bagaimana mencatat dan menyimpan data penduduk yang terkena setiap jenis bencana tersebut.*

**Kata kunci:** Perubahan Iklim, Migrasi, Populasi.

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Published under Department of Communication and Community Development Science, IPB University and in association with Ikatan Sosiologi Indonesia

E-ISSN: 2302-7525 | P-ISSN: 2302-7157

## INTRODUCTION

The influence of humans on the climate system is very real with the enormous contribution of greenhouse gas emissions in the second half of the century. In the 5<sup>th</sup> IPCC (2014) it is stated that climate change has had a profound effect on the natural and human systems. Population growth and economic activities have been the main drivers of greenhouse gas emissions which cause global warming and climate change. Climate change results in natural disasters, which occur either in slow-onset or rapid-onset hazard, slowly or suddenly. However, the frequency, intensity, duration, time, and location of the disaster events cannot be predicted with certainty (IPCC, 2014). Natural disasters due to climate change will reduce the living space of the people, which in turn will lead to massive migration and displacement from the area of origin to a new place that is considered better (Mbaye, 2017).

Although migration is a reasonable choice for disaster-affected households, the implications of climate change on migration are not yet understood or agreed upon by experts (Bardsley & Hugo, 2010; Piguët et al., 2011). At first, it was believed that climate change would encourage international migration in developing countries, but recent evidence shows that internal migration (displacement) is more common (Waldinger, 2015). The World Bank estimates that in 2150 there will be a wave of refugees (internal migration) of 143 million people in Asia, Africa, and Latin America if the governments of these countries do not make development policies related to reducing the impact of climate change (Rigaud et al., 2018).

Population movement is driven by economic, social, demographic, political, or environmental factors in the area of origin, coupled with factors in the destination area such as transportation costs, place to stay, and local politics. Climate change has become a driving force for population movement through environmental pressures, because its consequences have reduced the quality of the environment. Such environmental degradation or damage can lead to natural disasters that are rapid and sudden or slow-onset type. The type of population movement, therefore, depends on the nature of the natural disaster that occurs in a certain area. It can be in a form of permanent or non-permanent migration or temporary displacement. It can involve the whole family or only particular family member, and they can move internally or internationally.

In order to deal with slow-onset natural disasters, such as sea level rise or drought, households affected by the disaster will decide to increase their living space by sending household members to particular destinations. However, if they face a rapid-onset hazard such as floods or hurricane that destroys their living space, they will immediately move the whole family to a safer place, without any prior planning. Usually they will return to their home if the situation allows.

This article explains how population growth and migration will influence and be influenced by a global climate change. There are six sections in this article. Following the introduction, the relation of population and climate change will be described briefly. The third section is a review of literature to elucidate migration and climate change. The fourth section defines the conceptualization of the relationship between migration and climate change. The fifth section is a special study of empirical data to analyze the relations of natural disasters and migration in Indonesia. Conclusion and policy suggestion will close this article. The basic method of this writing is a literature review and a secondary data analysis of the 2015 Inter-Census Survey of Population (SUPAS) and 2013 disaster data related to population migration and disasters in Indonesia. Policy recommendations related to population, migration, and climate change are proposed to reduce the impact of climate change, and to increase the degree of disaster preparedness of the people and the government. The weaknesses of this paper are the lack of empirical research results related to this topic, and the different definitions used to measure the migration activity at the BPS-Statistics Indonesia and other institutions that handle disaster issues in Indonesia.

## POPULATION AND CLIMATE CHANGE

Population growth is one of the factors that accelerated socio-economic transformation during the past half-century (Hugo, 2011). The world population is currently more than 7.7 billion people and continues to increase so that it is estimated to reach around 11 billion by 2100. People, based on their instincts, want to ensure the sustainability of their existence on this earth by utilizing natural resources

to enhance their economy. Residents use natural resources and the environment in two forms, namely: 1) consumption of natural resources such as land, food, water, fossil fuels, and minerals, and 2) production of consumption wastes in the form of water and soil pollutants, toxic materials and greenhouse gases. The population that continues to grow will eventually harm the environment due to the effects of excessive agricultural practices, deforestation, pollution of water sources, eutrophication (water pollution caused by the emergence of excessive nutrients into freshwater ecosystems), and global warming.

Based on the IPCC (2014) IPCC human influence in the climate system is clear. The contribution of greenhouse gas emissions from human activities is caused by population growth and a variety of human activities for survival. Since the beginning of the industrial revolution in the mid-18th century, human activity has greatly increased the concentration of greenhouse gases in the atmosphere. Sources of greenhouse gases from human activities include fossil fuel combustion activities – for industrial activities, transportation or lighting – which increase CO<sub>2</sub> concentrations, agricultural and forestry activities through changes in land use for agriculture and animal husbandry, cement processing, and the use of aerosols (CFCs) for household use. Anthropogenic and non-anthropogenic gas emissions are the dominant cause of global warming observed since the mid-20th century. Greenhouse gas emissions due to human activities may have influenced the global water cycle since 1960 and contributed to sea-level rise since the 1970s.

Viewing the role of the population in disruption of the global climate with a growing number of people and the increasingly thin ability of natural resources to support life has reminded us of Malthus's postulate of population growth limits. Besides the total population, various other factors must be considered in explaining how the human population creates and contributes greenhouse gas emissions to the atmosphere, namely: distribution and composition, and how natural resources will affect the amount of greenhouse gas emissions (Dover & Butler, 2015; Murtaugh & Schlax, 2009) If you only pay attention to the population, then areas with a high population will be considered as a source of greenhouse gas emissions. The population is unevenly distributed with different natural resources and environmental conditions, with different survival needs. Humans consume planet earth differently and unevenly. To reduce population pressure on planet Earth, in addition to controlling the population, we must also change the way it is consumed.

Table 1 Regions in the world by population (2019)

No	Region	Population (2020)	Yearly Change	Net Change	Density (P/Km <sup>2</sup> )	Area (Km <sup>2</sup> )	Migrants (net)	Fert. Rate	Med. Age	Urban Pop %	World Share
1	Asia	4.584, 8	0,87 %	39,67	148	31,03	-1,55	2,15	32	50,2 %	59,4 %
2	Africa	1,320,0	2,49 %	32,12	45	29,64	-0,46	4,42	20	41 %	17,1 %
3	Europe	743,1	0,06 %	0,45	34	22,13	1,06	1,62	43	74,5 %	9,6 %
4	Latin America and the Caribbean	658,3	0,97 %	6,29	33	20,14	-0,33	2,03	31	80,4 %	8,5 %
5	Northern America	366,5	0,73 %	2,65	20	18,65	1,11	1,85	39	83,8 %	4,8 %
6	Oceania	41,8	1,37 %	0,56	5	8,48	0,17	2,33	34	70,3 %	0,5 %

Source: "Regions in the world by population 2019".

<https://www.worldometers.info/world-population/population-by-region/>

Table 1 shows the statistics of the world population by region in 2019. If you only pay attention to the population, then the population living in the continents of Asia and Africa is the main source of environmental damage because this is the largest number in the world, reaching 76.5 percent of the total world population. Africa's population will potentially contribute more greenhouse gas emissions because population growth is still very high, i.e. 2.49% with a very high fertility rate of 4.42. The population of Asia, although the number is the highest in the world, has already experienced a low population decline (0.87% per year) with a fertility rate slightly above the level of replacements, so it is thought to have contributed very large greenhouse gas emissions. Other regions, Europe, America, and Oceania have the smallest population with very low growth, so it is suspected that their contribution to global warming is small.

Is that the situation? The population can be considered insignificant in producing greenhouse gases without regard to their composition and consumption patterns. Figure 1 shows the ecological footprint of countries in various regions of the world. It appears that countries with the highest and high quality of life, measured by the index of human quality of life (HDI), are on the continents of Europe and North America, as well as several in Asia and the Middle East. Meanwhile, the majority of countries in Africa are in the lowest HDI figures. Then if we consider the pattern of natural resource consumption, from the size of the ecological footprint, the majority of countries with high HDI have high ecological footprint rates, far above the world's biocapacity. Global biocapacity has also declined, compared to that between 2011 and 2014.

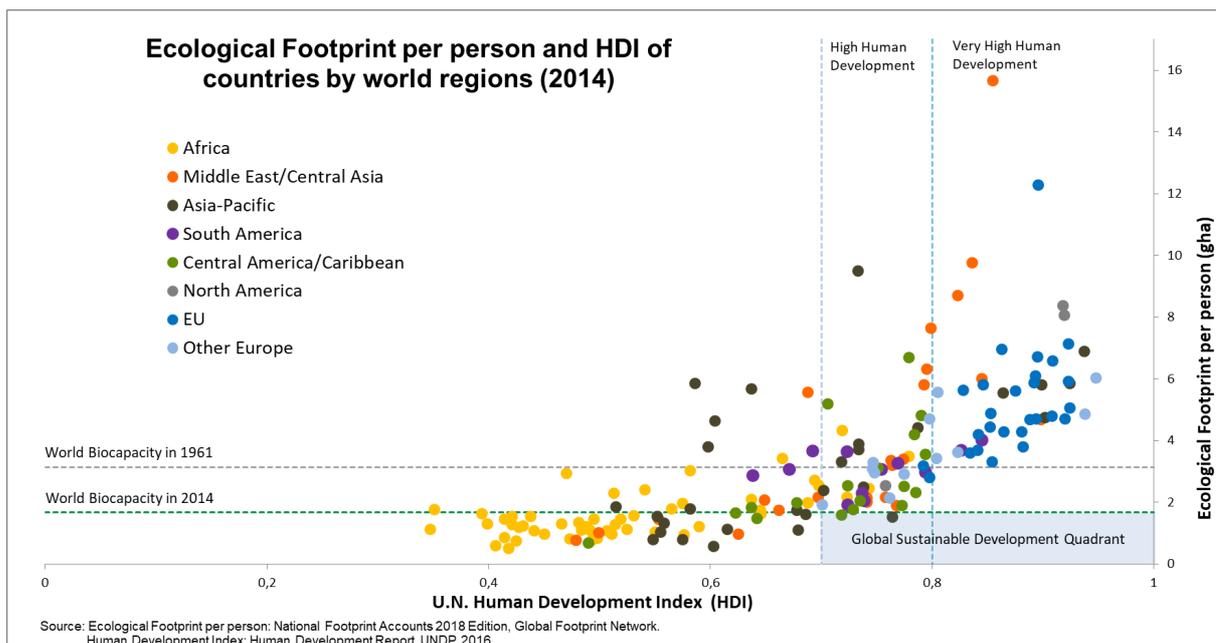


Figure 1. Ecological Footprint per person and HDI of countries by world regions 2014  
 Source: <https://www.footprintnetwork.org/2013/04/03/human-development-ecological-footprint/>

Meanwhile, the countries with the lowest HDI, on average, have the lowest ecological footprint value, even below world biocapacity. It can be said that most of the countries in the world with low biocapacity with high ecological footprints are ecologically indebted to countries that have high biocapacity with a low ecological footprint. Based on statistics on population and consumption of natural resources above, three things must be done to reduce greenhouse gas emissions and ensure the sustainability of the planet's earth – by continuing to reduce the pace of population growth and various efforts to change the pattern of consumption of natural resources, as well as increasing Earth's carrying capacity by using environmentally friendly technologies and innovations (Dovers and Butler, 2015).

## **MIGRATION AND CLIMATE CHANGE**

Table 1 also presents statistics on net international migration in the various regions of the world. Net migration is the difference between incoming and outgoing migration. If the net migration rate is negative, it means the outgoing migration is higher than the inward migration; conversely, if the net migration is positive, it means that there is more in-migration than out-migration. The migration statistics in Table 1 shows that Asian, African, and Latin American regions have more out-migration than in-migration, while Europe and North America receive more migrants than outmigrants. This situation shows that Europe, North America, and Australia are more hopeful areas of life than other regions. However, it does not explain the reasons for the migration, whether it is due to economic, political, social, or environmental pressures. Based on the classical economic development theory, conceptually, migrants move from less-developed areas to better-off ones (De Haas, 2010), for a better economic opportunity, and mostly driven by economic reasons. Environmental migration is only discussed recently, although Revenstein in 1889 has already mentioned it in his article “The Law of Migration” (Piquet et al. 2011). Recent studies on the effects of climate change on migration in developing countries show that people affected by climate change prefer to move or mostly migrate internally (Oliveira & Pereda, 2020; Waldinger & Fankhauser, 2015)

Population growth plays an important role in the vulnerability to climate change impacts and contributes to climate-induced migration (Population Action, 2010; Stephenson et al., 2010). However, in the discussions of adaptation strategies and climate-induced migration development, the population factor is often overlooked (Population Action, 2010). Rapid population growth will increase the consumption of natural resources and reduce the ecosystem quality, which are the key factors in climate-induced migration. Countries that are less able to cope with climate change have also experienced a high population growth rate. Geographical areas most vulnerable to climate change often overlap with rapid population growth. People move from one place to another to look for any opportunity for a better life, and climate change will be a trigger for population migration that is getting bigger in number and more complex in characteristics. Population displacement due to slow-onset natural hazards such as sea level rise or drought, may need different responses and treatment with one that is caused by rapid-onset natural hazards such as floods or hurricanes (Adamo, 2011; Mbaye, 2017). Disruption to ecosystem-dependent life will remain the main driver of long-term migration in the next 2 to 3 decades, and climate change will sharpen this situation.

In the 4<sup>th</sup> IPCC (2007), it was stated that climate change will encourage massive population migration, and that possibility is international migration. However, in the 5<sup>th</sup> IPCC (2014) it was stated that climate change would lead to an increase in the movement of population internally (displacement as a way out for people affected). The ability of affected people to determine the destination area, form, and time of migration will increase their adaptive strategy preparedness to climate-induced disasters. The government should have a policy to manage the population movement during the onset and aftermath of a disaster event. However, the planning and implementation stages of population movement management are not an easy task to be taken care. The number of internally displaced persons (IDPs) to be rescued or transferred is difficult to predict, because there is a degree of uncertainty of disaster event to take place – where, when, and what magnitude. In addition to the uncertainties, the ability of residents’ response to disaster events and their adaptive behavior vary, and the government’s readiness to cope with disasters also varies. Nevertheless, people and the government should have a disaster preparedness plan.

## **CONCEPTUALIZATION OF THE RELATIONSHIP BETWEEN MIGRATION AND CLIMATE CHANGE**

The implication of environmental change on migration is not yet fully understood (Bardsley & Hugo, 2010; Piquet et al., 2011) although recent research suggests that environmental migration is most likely to be in a form of internal movement (Oliveira & Pereda, 2020; Waldinger & Fankhauser, 2015). Bardsley & Hugo (2010) stated that environmental migration indicates the inability of the affected area to perform the right adaptive strategy. Environmental-migration decision making is a

process to consider what to expect. Migration is a decision on the expectations and perceptions of climate change in the future. Migration due to natural disasters can trigger conflicts between residents of migration destinations and climate migrants because they fight over the remaining resources. If migration due to climate change can be effectively managed, then the possibility of conflict can be avoided, meaning that the social boundaries for adaptation can be expanded.

There are two types of natural disasters as a driving force for migration, namely disaster events that occur quickly and slow emergencies. Disaster events resulted from extreme weather, such as earthquakes or floods, cause displacement of people, or they must be moved quickly. Meanwhile, due to slow weather changes such as drought or erosion that occur more frequently, people are able to adapt to survival and create new living systems under the capacity of natural disasters that occur.

According to Tacoli (2009) migration reflects the failure of adaptation to a changing environment due to climate change. Climate change affecting migration has been one of the factors of migration since long ago (Piguet et al., 2011). Environmental and climate factors are related to the pull and push factors of migration. The impact of climate change will continue to be related to migration. According to Baldwin (2017), the impact of climate change will be one of the determinants of decisions for migration in the present and the future. Mortreux & Barnett (2009) and Jha et al., (2018) state that people's perceptions and experiences of environmental changes are factors for migration.

Population movement is a common occurrence when people are exposed to climatic shock or natural disasters; it is because their livelihoods are damaged (Mbaye, 2017). Thus, migration is a response to natural disasters, both short-term or long-term migration (Jha et al., 2018). Natural disasters that occur suddenly and strongly, such as tropical storms, heavy rains, and floods, have short-term and internal migration impacts (Piguet et al., 2011), and the migrants will return to their original places when they are safe (Tacoli, 2009). Meanwhile, long-term climate change events, such as drought, can trigger long-term migration. Drought will be a definite source of environmental change, and people in the region will migrate as a solution to survive (Baldwin, 2017). Events related to long-term climate change tend to be preventable, and their effects tend to be reduced, so residents in the affected area will be able to adapt eventually.

### **Population Statistics, Migration and Natural Disasters in Indonesia**

As explained earlier, climate change has become one of the factors that cause more environmental disasters/damage that has occurred lately. Climate change will produce higher temperatures, more intense rainfall, and more extreme weather events, such as droughts, storms, and floods (Brown, 2007). McAdam & Ferris (2015) state that climate change can cause an increase in natural disasters that occur unexpectedly and force someone to move. Another model is that climate change has an impact on the environment and causes natural resource conflicts, economic inadequacy, and again encourages someone to go. Data from the Internally Displacement Monitoring Center IDMC (2017) said that natural disasters caused 853,000 Indonesian citizens to move in 2018. Respectively the earthquakes that happened in July and September in Lombok and Palu forced 445,000 people and 248,000 people to flee to safer locations, while a total of 82 flooding events caused 67,000 new population movements. Trends in population movements caused by disasters (Internally Displaced People / IDPs) in Indonesia over the past 10 years are presented in Figure 2.

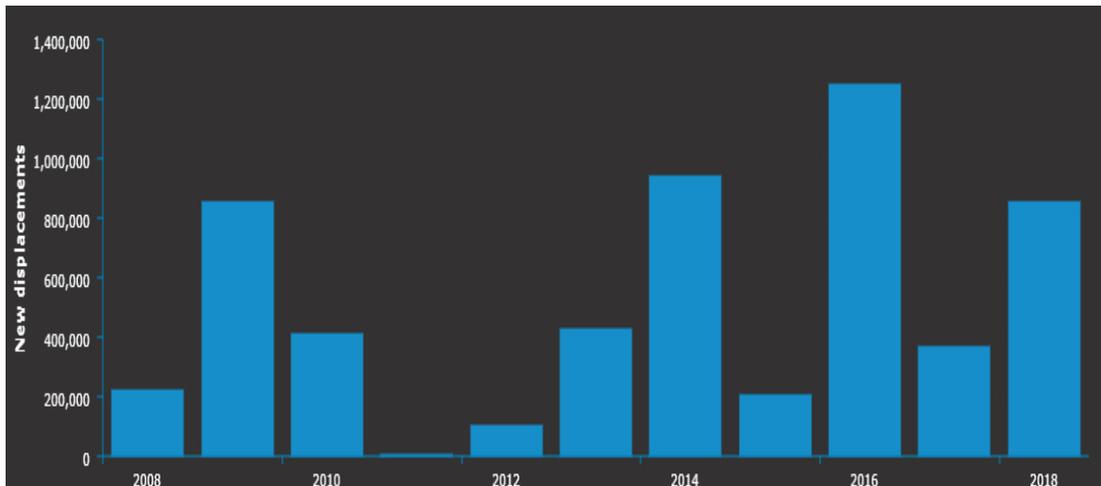


Figure 2. Disasters IDPs number in Indonesia 2008-2018

Source: IDMC (2018) <http://www.internal-displacement.org/countries/indonesia>

The number of Indonesian IDPs due to disasters presented in Figure 2 is included in the high category compared to other countries in the world. IDMC data shows that in 2016, Indonesia ranked the 4th highest after China, the Philippines, and India in terms of the number of IDPs due to disasters among countries in the world, as presented in Figure 3.

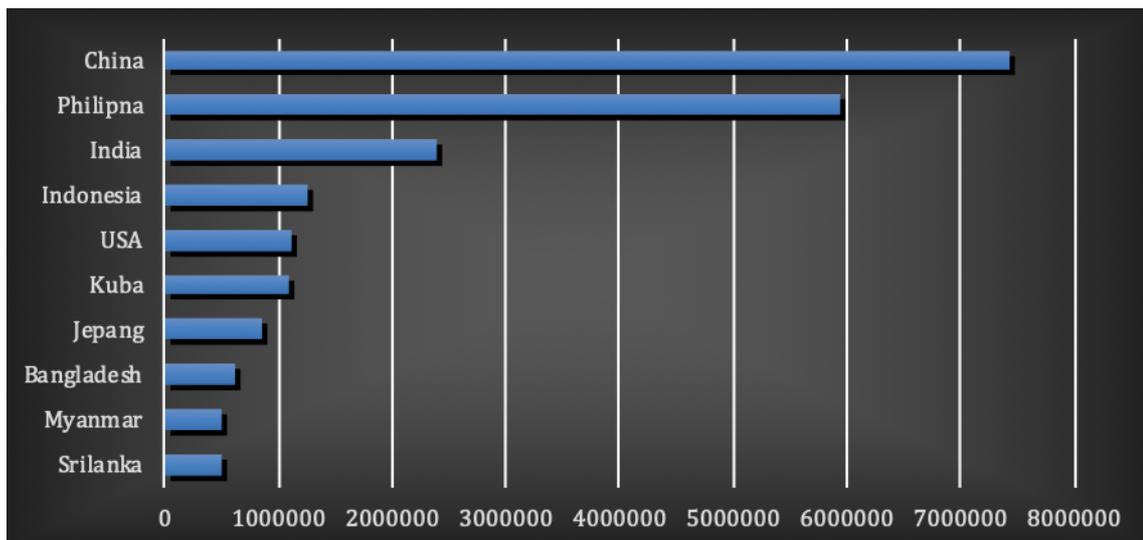


Figure 3. Countries with the newest displacements by disasters in 2016

Source: IDMC (2017)

The Indonesian population movements caused by disasters (IDPs) can be either in permanent or non-permanent types. The non-permanent type of migration could be taken in the form of temporary disaster displacement. It refers to people who migrate out to another place due to disaster or conflict and will eventually return to their original place once the disaster or conflict subsides. This is as explained by the UN and IDMC (2018) which states that they are not able to predict whether people who move because of the disaster will settle in a new place permanently or only temporarily. Therefore, there may be areas that have high IDPs with a low disaster-induced migrant number. To provide an overview of the profile of migration and natural disasters in Indonesia, 2015 SUPAS data and BNPB data on the 2013 Indonesian Disaster Risk Index (IRBI) are used. The 2015 SUPAS data is processed from raw data adjusted to analysis needs and IRBI 2013 data is processed from (Badan

Nasional Penanggulangan Bencana, 2014). Due to the limited scope of migration data, both in SUPAS 2015 and IRBI 2013, the analysis can only be done at the provincial level.

Migration data used is total migration data, both incoming, outgoing, and net. Total migration includes all migration events, both lifetime migration (where the province of birth is different from the current province of residence), and the migration of risen (the province in the survey was different from the provocation of residence 5 years ago). The total in-migration figures show the number of in-migrants per 1,000 inhabitants of the destination area, while the total out-migration figure shows the number of outbound migrants per 1,000 inhabitants in the area of origin. The difference between the total in-migration and out-migration of total migration is called the net-migration rate. A net migration rate with a positive value indicates that there are more in-migrants than out-migrants in the area, while a negative net-migration value indicates the opposite. As additional information, the percentage of migrants who move because of the main reason for disasters in the area of origin is presented.

As for the description of natural disasters, Indonesia's 2013 disaster risk index data is used. Disaster risk is an assessment of the likelihood of the predicted impacts if the hazard becomes a disaster. Thus, the present calculation emphasizes the potential likelihood and magnitude of the impact measured from the exposure (exposure) of each hazard (hazard) and a combination of several existing hazards (multi-hazard). Therefore, this risk index is calculated from the potential likelihood of victims and the impact that will result from a disaster. The results of this calculation are in the form of disaster risk index scores and their classification in the risk classes. This disaster risk index is measured for each type of disaster, such as drought, flood, and extreme weather, and there is also a multi-threat disaster risk index which is a combination of all types of disasters. In Table 2, the population density, total migration rate, percentage of migrants according to the main reasons for migration, and multi-threat disaster risk index in each province in Indonesia are presented.

Table 2 Population density, Disaster In-migrant, and Multi-threat Disaster Risk Index by the province in Indonesia 2015

No	Province	Population Density persons/k m <sup>2</sup>	Total Migration Number			Disaster In- migrant (%)	Multi-threat Disaster Risk Index	
			In- migrati on	Out- migrati on	Netto		Score	Category
1	Aceh	86	47,06	51,57	-4,51	0,08	160	High
2	Sumatera Utara	191	46,72	136,18	-89,46	0,26	150	High
3	Sumatera Barat	124	113,38	187,64	-74,26	0,08	153	High
4	Riau	73	277,15	80,44	196,70	0,00	147	High
5	Jambi	68	203,96	82,43	121,53	1,43	142	Moderate
6	Sumatera Selatan	88	121,13	92,68	28,46	0,34	142	Moderate
7	Bengkulu	94	183,82	71,50	112,32	0,00	172	High
8	Lampung	234	156,12	95,12	61,00	0,02	153	High
9	Bangka Belitung	84	141,20	74,25	66,94	0,00	162	High
10	Kepulauan Riau	241	443,83	113,31	330,51	0,02	116	Moderate
11	Jakarta	15 328	341,61	455,08	- 113,47	0,52	103	Moderate
12	Jawa Barat	1 320	109,29	56,62	52,66	0,16	166	High
13	Jawa Tengah	1 030	63,43	161,70	-98,28	0,05	158	High
14	Yogyakarta	1 174	189,03	231,09	-42,05	0,32	165	High
15	Jawa Timur	813	35,05	87,58	-52,53	0,10	171	High
16	Banten	1 237	202,23	73,00	129,23	0,04	180	High
17	Bali	718	106,09	76,16	29,93	0,06	170	High
18	Nusa Tenggara Barat	260	64,42	41,95	22,47	0,01	172	High
19	Nusa Tenggara Timur	105	56,42	45,99	10,43	0,75	156	High
20	Kalimantan Barat	33	64,00	41,52	22,48	0,17	157	High
21	Kalimantan Tengah	16	208,78	77,75	131,03	0,00	141	Moderate
22	Kalimantan Selatan	103	128,38	88,91	39,47	0,01	152	High
23	Kalimantan Timur	27	308,35	89,71	218,64	0,00	164	High
24	Kalimantan Utara	9	292,74	114,71	178,03	0,00		
25	Sulawesi Utara	174	85,31	86,60	-1,29	0,08	151	High
26	Sulawesi Tengah	47	251,69	51,35	200,34	0,11	158	High
27	Sulawesi Selatan	182	178,70	157,74	20,96	0,08	167	High

No	Province	Population Density persons/k m <sup>2</sup>	Total Migration Number			Disaster In-migrant (%)	Multi-threat Disaster Risk Index	
			In-migration	Out-migration	Netto		Score	Category
28	Sulawesi Tenggara	66	307,90	80,91	226,99	0,00	169	High
29	Gorontalo	101	141,53	94,52	47,00	0,00	140	Moderate
30	Sulawesi Barat	76	236,02	91,94	144,08	0,00	191	High
31	Maluku	36	87,66	127,85	-40,19	0,01	179	High
32	Maluku Utara	36	104,08	59,33	44,75	0,00	169	High
33	Papua Barat	9	304,95	96,47	208,47	0,20	154	High
34	Papua	10	148,71	52,52	96,19	0,02	125	Moderate
<b>Indonesia</b>		134						

Sources: Indonesia Intercensal Population Survey 2015; disaster data (BNPB 2013)

From Table 2, it can be noted that the provinces of West Sulawesi and Banten are the two provinces with the highest disaster risk index in Indonesia, namely successively: 191 and 180. However, if we analyze the figures of out-migration and total migration, it appears that West Sulawesi and Banten are not included in the provinces that are mostly abandoned by residents; even as much as 0.04% of the population outside Banten migrated to Banten because of disasters in their home regions.

Another analysis was from 9 provinces that did not go to migrants because of disasters and environmental damage, 7 of which or around 78% were regions with a high disaster risk index. The three provinces most frequently visited by migrants for reasons of disaster / environmental damage are Jambi, East Nusa Tenggara, and Jakarta. Jambi and Jakarta are regions with a moderate disaster risk index, and only East Nusa Tenggara which is mostly visited by migrants for reasons of disaster/damage environment even though the province is included in the province with a high disaster risk index. Thus, there is no specific pattern that can describe the relationship between disaster and population migration. People can migrate from or to areas that have high disaster vulnerabilities. Naik (2009) argues that migration to disaster-stricken areas can occur for a variety of reasons, such as: seeking employment opportunities in the reconstruction period, helping and supporting family members, or that the disaster area continues to develop and has the potential to become an economic center. Although Indonesia experiences many disaster incidents every year, the number of IDPs is low. The explanation of this is because the majority of IDPs are only move-out from their disaster-affected areas in temporary-bases. Once, their origin areas have recovered, they will move back. To be able to make a more accurate analysis related to the relationship between migration and disaster, BPS needs to create a new definition related to migration and displacement.

## CONCLUSION

The influence of humans on global warming which is the cause of climate change is increasingly clear, especially since the industrial revolution. Humans influence climate change because of their increasing numbers and their economic activities that have increased greenhouse gas emissions. This climate change will then have an impact on the human system and nature. Climate change that affects natural systems will reduce the quality of the environment to support the lives of residents.

To tackle climate change, the population, among others, conduct population movements or migration. The choice of migration patterns, for example, permanent or non-permanent, circular or commutation, internal or international, will be chosen by the population as an adaptation strategy to climate change.

Responses to the impacts of climate change, social and economic capacity to carry-out migration, and regulations related to population migration will shape migration patterns due to climate change.

Research on the relationship between migration and climate disaster events using 2015 SUPAS data and 2013 natural disaster data shows that population migration rates are generally caused by economic needs, while migration due to disasters is very small. Even then, for migration of all types of disasters, no data specifically count migrant populations due to climate change. This is related to the definitions used in migration data and the behavior of population movements due to disasters. Generally, the affected population will move temporarily until the area of origin returns to normal, then if migration is an adaptation strategy generally the population do not move permanently but have jobs or change jobs to the non-agricultural sector in the city (Islam & Shamsuddoha, 2017).

## **POLICY SUGGESTIONS**

The State Bureau of Statistics and the National Disaster Management Authority should have some agreement in defining disasters, including climate change induced-disasters, and in collecting and storing data on the number of people impacted by each of the disasters. In this matter, the State Bureau of Statistics has to elaborate the definition of migration used for population census and survey to accommodate emerging types of non-permanent bases migration, as a consequence of the new practices of economic activity, and the more frequent natural-disaster events. In-line with that, the National Disaster Management Authority should provide more specific data and information on any disaster event that occurs in a particular time and location, which covers the type of disaster, time and location, population impacted and casualties, ecological damage, and other relevant information. The availability of data and information will make a more accurate analysis related to the relationship between migration and disaster in Indonesia.

The central government and the regional apparatus need to work together to create a road map to build a climate change knowledge center to support community in strengthening their knowledge of climate change impacts and behavioral attitudes that need to be taken as adaptation mitigation measures. For this reason, it is necessary to carry out direct and indirect campaigns through various social media, so that awareness will arise for communities at risk of being affected by disasters due to climate change. The formation of small groups and the deployment of experts (climate change knowledge instructors) integrated with agricultural extension workers and other development activity programs will be very effective and efficient and can soon be built up and carried out to the remote villages. This can be integrated with village midwife experts, agricultural extension workers, family planning (family planning) / other health counselors, schools, *Posyandu*, PKK, the smallest NGO groups in certain areas. Thus, it is expected that knowledge transfer and capacity building of communities at risk of being affected and becoming victims of disasters due to climate change can be achieved, and independent mitigation and adaptation can be created in these communities.

## **ACKNOWLEDGMENT**

We would like to thank Dr. Ir. Machfudz M.P., Director of the Center of Data and Information at the Ministry of Environment and Forestry of Indonesia who granted permission to publish this research paper in English. The original article is published in Book Three of Trilogy “Indonesia Menghadapi Perubahan Iklim” by the Ministry of Environment and Forestry of Indonesia. We would also thank the Editors of the Trilogy to allow us to participate as one of the writers. The content of this research paper is our responsibility.

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