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Future Flood Management and Control Policies: A Comparative Study of Europe and Indonesia

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Abstract: Human activities have caused changes in land use, climate, and rainfall in the last few centuries, one of which is marked by an increase in the occurrence of floods. Flood events in Europe in the period 1998 – 2009 caused more than 1100 damage and displacement of more than one million people. To overcome this, the European Commission (EC) published the Flood Directive 2007/60/EC (FD) with the aim of reducing and managing flood risks for human health, the environment, natural resources, and economic activities. This paper aims to determine the policies and management of the government and the community towards flood disaster management in the future from the results of research conducted in countries in Europe (Portugal, Slovenia, Serbia, and Bosnia & Herzegovina) and then a comparison is made with conditions in Europe. Indonesia to see the differences and similarities in the perception of the government and the public regarding policies and management of flood events that occur in Indonesia. Provision of infrastructure requires not only technical and financial capacity but also appropriate coordination between different government agencies. Disaster risk reduction through appropriate land use planning and control is an important instrument for securing urban areas from flooding (as a result of a case study in Indonesia). Perceptions of future flood management and control policies require serious attention from various lines, especially within the government as policy makers and the community as implementers in the field.

Keywords: flood, policy, disaster, planning, management

INTRODUCTION

Flood is a big problem for some parts of the earth. In the period 1970 to 2012 hurricanes and floods killed more than one million people (WMO, 2014). Floodplains are often areas of interest for human development and a large part of the world's population depends, both directly, on a number of key natural resources that floodplains generally provide. The recurrence of extreme rainfall anomalies resulting in floods or droughts is a normal component of natural climate variability. The adverse effects of floods and droughts often require a range of socioeconomic and environmental implications. The level of vulnerability to such natural hazards is high in developing countries, where most of the vulnerable areas of developing countries are inhabited by poor people.

Several global problems, including increasing population pressures, ongoing degradation of ecosystem services, and climate variability and change, may contribute to a further increase in flood risk worldwide. In many parts of the world, this increase is further exacerbated by inadequate flood management planning and practices.

Human activities have caused changes to land use, climate, and rainfall in the last few centuries, one of which is marked by an increase in the occurrence of floods (EEA, 2016). Flood events in Europe in the period 1998 – 2009 caused more than 1100 damage and displacement of

more than one million people. To overcome this, the European Commission (EC) published the Flood Directive 2007/60/EC (FD) with the aim of reducing and managing flood risks for human health, the environment, natural resources, and economic activities. Apart from Europe, similar things are also being done in other parts of the world, one of which is Indonesia. The concept of flood resistance is researched in the Jakarta area, the operational concept includes and understands the desired features, as well as barriers that affect the community, with flood resilience covering the main stakeholder groups (stakeholders), disaster risk reduction (DRR), and climate change adaptation and development (Dwirahmadi et al., 2019).

Europe has had more than 400 significant floods in the last 20 years alone, many of which were catastrophic. These floods affected more than 8.7 million people, claimed more than 2000 lives, and caused financial losses of more than 72 billion Euros (WHO, 2017). Europe has had numerous flood disasters over the course of the last few decades that have been accompanied by a lot of rain. The following floods rank among the most expensive and destructive in various regions of Europe: the 1993 and 1995 winter floods in Germany, the Netherlands, and France (Ionita et al., 2020); the damaging floods of 2002 and 2013 in the catchment of the Elbe River (Ionita et al., 2015); the floods of 2005, 2008, and 2010 in the east of Europe (Ionita, 2015); the floods of 2010 in the center of Europe (Bissolli et al., 2011); and the floods of 2000, 2007, and 2014 in the United Kingdom (Stevens et al., 2016).

The 'Floods' Directive sets out a basic framework for good practice in flood risk management, comprising a screening exercise (the PFRA) to identify the APSFRs, and then the preparation of flood maps for these areas, and the preparation of FRMPs to set out a set of measures to address the flood risk in the APSFRs. The implementation process has been supported by the EU WG F, that has not only permitted information exchange related to the Directive, but has also provided for information exchange to help improve flood risk management generally across Europe, has established a European network of flood risk management authorities and also provides a focal point for flood risk management in Europe (Adamson, 2018).

The purpose of the review paper entitled Flood legislation and land policy framework of EU and non-EU countries in Southern Europe is to know the policies and management of the government and the community towards flood disaster management in the future. From the results of research conducted in countries in Europe (Portugal, Slovenia, and Serbia & Herzegovina) then a comparison is made with conditions in Indonesia to see differences and similarities in the perceptions of the government and the public regarding policies and management of flood events that occur in Indonesia

STUDY AREA

Framework of Thinking

Framework of thinking in this study consisted of three stages (Figure 1). The first stage is to see how the administrative structure of existing flood control policies is based on the frequency of floods that occur in EU and non-EU countries. Then the same thing is also done by looking at how the government makes decisions and regulations on flood control. From these two things, an analysis is carried out on how regular policies can be carried out to reduce the impact of flood hazards, including in the form of regulations governing the condition of waters and floods. The results of the analysis include how the challenges that may occur in the future as well as recommendations are given in order to improve the calculation and integration in the future regarding sustainable water management with various regulatory sectors needed to reduce the risk of flooding that may occur.

Geographical Locations and Past Events

The study was conducted in EU (Portugal and Slovenia) and non-EU (Serbia and Bosnia & Herzegovina) countries that are affected by flood hazards (Figure 2):

a) Portugal

In Portugal, various types of floods were recorded, including fluvial floods, flash floods, fluvial floods, flash floods, and coastal flooding. In recent years, migration and related intensification of people in urban and coastal areas has led to high risk of fluvial and coastal flooding (ECHO, 2017). Most floods are characterized by brief flood events in response to intense rainfall events (Peña-Angulo et al., 2019). Floods are the second largest natural event that causes casualties and the economy damage (Terêncio et al., 2020). In the period 1865–2010, floods resulted in 546 people being killed, injured, or missing, and 3551 lost their homes. Between 2005 and 2014, fluvial flooding alone caused an average annual loss of EUR 115.8 million (Santos, 2015). Even though the human damage from the flood has been reduced. In recent years, material losses have increased due to the growing importance of urban flooding driven by expansion of watertight areas (Leal et al., 2020).

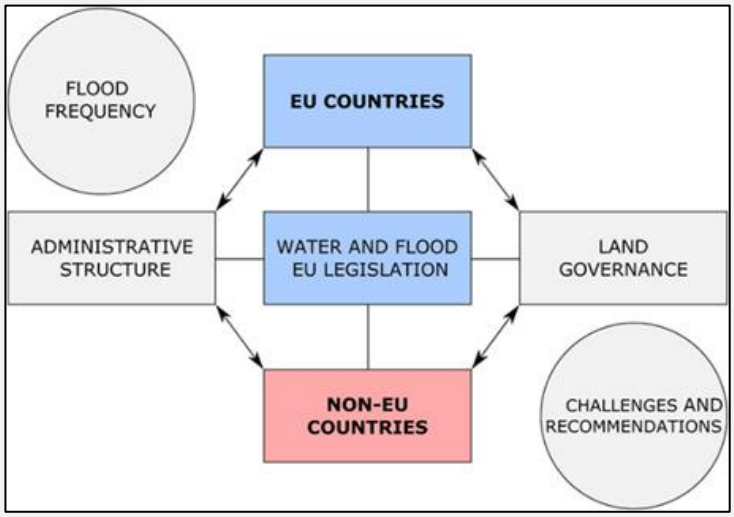

Figure 1. Research Framework
(source: Solomun et al., 2022, Research Framework)

b) Slovenia

Slovenia has a long history of flooding, and flash floods, major floods and karst floods are frequent annual occurrences (Mikoš, 2020). Most of the population lives in flood-affected areas because Slovenian settlements are highly fragmented (Hladnik, 2005), with a high proportion of urban areas next to rivers and streams. Floods in Slovenia endanger about 15% of the country's surface area (20,271 km^2, population 2 million) (Špitalar et al., 2020). Between 1926 and 2010, there were 17 major floods with 8 of them causing fatalities (Špitalar et al., 2020). An extreme rainfall event in September 2007, with a return period of >100 years, affected about a third of the country and resulted in human casualties and caused EUR 100 million in damage. In September 2010, Slovenia was hit by heavy and extensive rain: an average of 170–180 mm of rainfall fell over a 48-hour period which is the highest amount of rainfall accumulated over a two-day period over 60 years last, and caused flooding across the country (Špitalar et al., 2020), accumulating total gross damage of up to EUR 250 million.

c) Serbia and Bosnia & Herzegovina.

In Serbia, flooding is the most common and most significant natural disaster in terms of loss of human life and material damage. Generally, floods in Serbia cause material damage estimated at more than EUR 12 billion (Ristic et al., 2012). Floods are the most frequent natural disaster in B&H, because 75% of the country's territory is located in the cross-border area of the Sava watershed (Solomun et al., 2018; Solomun et al., 2020). Biggest flood to date in Bosnia occurred in 2014, displacing 90,000 people and affecting a total of about 81 of the 143

municipalities. Total damage and losses in excess of EUR 2 billion, which is equivalent to 15% of GDP. The agricultural sector is the most affected with a total damage and loss of EUR 140 million (EUR 78 million damage and loss of EUR 62 million) (FAO, 2020). Human impacts such as deforestation (especially during and after war) and development Illegal housing by refugees in flood prone areas is another reason why heavy rain can result in extensive inundation and flooding across the country. Many areas of the two countries are still affected by flooding and climate change with higher rainfall, unsustainable forest exploitation, and traditional agricultural land management has the potential to exacerbate the incidence and frequency of floods.

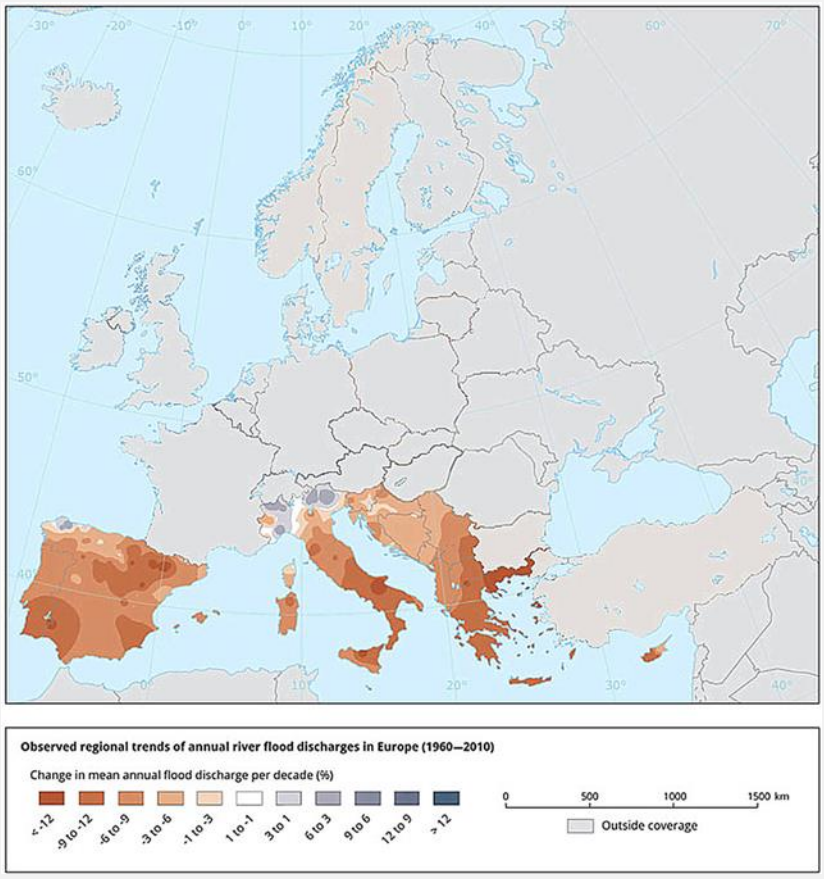

Figure 2. Annual flood trend in Europe 1960 – 2010
(source: Solomun et al., 2022)

DATA AND METHODS

This research uses analysis using a comparative method to compare how flood risk is managed between EU and non-EU countries. The comparative analysis and evaluation of flood disaster management in the selected countries is collected in Table 1.

Although the FD was published in 2007, Portugal, with earlier accession to the EU than Slovenia, was more advanced in terms of its implementation, especially regarding the revision of the PFRA in the second cycle and its stipulation hydrological network to support flood adaptation and mitigation plans. Serbia and B&H as non-EU developing countries. The country faces many challenges in implementing this directive, ranging from its transposition into a national legislative framework, exacerbated by a complex administration and weak economic situation.

Non-EU countries face many challenges such as complex political situation, governance and administration which are not able to fully efficiently transfer FD. The legislative framework for land

management and spatial planning does not consider flood risk management, which is an important barrier to flood mitigation in Serbia and B&H. This issue is particularly prominent in B&H as a post-conflict decentralized country with complex administration and state institutional frameworks (13 Ministries of Agriculture, Forestry and Water Management jurisdictions for flood management) acting out of sync.

Table 1. Comparative Analysis

Country	Serbia	B&H	Slovenia	Portugal
EU Membership	Not member	Not member	EU member	EU member
Type of Governance	Centralized	Decentralized	Centralized	Centralized
Economic status of the country	Developing	Developing	Developed	Developed
Implementation of EU FD	Partially transposed into national legislation	Partially transposed into entity and district legislation	Fully aligned	Fully aligned
Competent authority for flood risk management	MAFWM and public water management companies (three of them)	MAFWM RS MAFWM FBiH MAFWM BD and Public water management companies (three in RS, twi in B&H))	Administration of RS for civil protection and disaster (Ministry of Defense) Slovenian Environment Agency (Ministry for Environment and Space)—forecast and warning issue	Portuguese Environmental Protection Agency
Completion of flood risk management instruments (number of PFRA and FRMP)	101 PFRA 36 FRM Completed	131 PFRA 102 FRMP Separately in entities without synchronization. Completed	86 PFRA Completed	63 PFRA 8 FRMPa Completed
Type of measures Implemented	Structural	Structural	Structural and nonstructural	Structural and nonstructural
Spatial aspects of flood risk management/ land management/ spatial planning	Flood risk management is partially included in land management and spatial planning regulations, but implementation is weak	Flood risk management is partially included in land management and spatial planning regulations on the entity and district levels, but implementation is weak	Water act Spatial management act Spatial aspects were considered for determination of APSFR	Planning regulation requires further updates in line with FRMP
Main challenges for	Weak environmental	Complex administrative	Intensive and scattered	Long-term hydrological

Country	Serbia	B&H	Slovenia	Portugal
implementation of Flood Directive	administrative sector Weak economic investment in measures for FRM	and institutional framework Post conflict environment and weak political cooperation among administrative units Weak economic investment in measures for FRM	urbanization of flood plain areas Uncertainty for flood forecast for smaller watersheds	data for proper assessment in some flood hazard areas Available data for cost–benefit analyses to support prioritization of measures identified in the FRMPs Integration of climate change adaptation measures in FRMPs Note: Source: Table 1 was prepared based on the review results of existing documents and legislation, and authors' interpretation of the available information.

(source: Solomun et al., 2022)

EU countries are obliged to implement FD, so that they are more advanced in setting flood reduction measures compared to non-EU countries. Non-EU countries are not officially required to follow the FD but can use it as a basis for their own laws. However, economic considerations and political complexity are important factors influencing implementation and bringing additional challenges.

RESULTS AND DISCUSSION

Evaluation of the Europe Flood Management

EU membership is an advantage for countries in terms of transposition and implementation of FD and generally flood adaptation and mitigation at the country level. Member States are obligated to implement the directive on a national scale, by implementing PFRAs for riverine and coastal areas, to identify high flood potentials. risk areas based on past events, mapping flood hazard and flood risk in those areas, and establishing a set of flood reduction actions, prioritized based on costs and benefits. EU countries are more efficient in their implementation from FD. Note, the date of joining the EU and the economic and political situation may affect the status of FD implementation. In addition, weak economies and complex land governance administrations in non-EU countries are significant barriers to increased flood resilience. This is in line with the complicated political situation of Serbia and B&H, where natural hazards including flooding are considered of secondary importance.

Implementing EU FD in Serbia and B&H requires a consistent policy framework that is implemented efficiently, supported by new strategies and approaches but also efficient administrative capabilities to align existing policy and legal frameworks with FD requirements. Increased administrative and decision-making capacity, with efficient political dialogue may be able to advance the implementation of FD in Serbia and B&H.

Advantages

Research conducted by Solomun et al. (2022) can explain how Portugal and Slovenia as part of the European Union can gradually implement the implementation of policies and mitigation of flood disasters. In Portugal, Solomun comprehensively explained how to develop a risk evaluation from flooding in the first period of FD implementation (2011 – 2017). Flood hazard and risk maps are developed in stages and prepared and distributed for public consultation. In developing the FRMP in Portugal, Solomun was able to explain well how to control floods in the form of prevention and protection such as the development of flood risk models, development of river technology, to specifically anticipate flash floods in a short period of time. Solomun also discussed the same thing when explaining the form of adaptation of FD in Slovenia. Protection and rescue plans in case of flooding are developed. The explanation in Solomun by integrating information on flood control and policies taken with the opinion of the Slovenian people becomes a special thing that can be observed. For example, the people of Slovenia prefer to have gray infrastructure in flood control which is considered more effective than flood-retaining reservoirs.

The comparative comparison table provided by Solomun et al. (2022) make it easier for readers to more easily grasp how the differences exist between Portugal, Slovenia, Serbia, and Bosnia & Herzegovina.

Deficiency

Research conducted by Solomun et al. (2022) focuses on two regions, namely the European Union and non-EU countries. The differences that appear from the two studies are more in the results explaining that EU countries such as Portugal and Slovenia are more successful in carrying out policies based on existing regulations than non-EU countries, namely Serbia and Bosnia & Herzegovina.

It is a little unfortunate that the author is unable to explain in detail what is meant as the cause of Serbia and Bosnia & Herzegovina being unable to carry out existing policies in flood control. Although it is stated that non-EU countries are faced with various challenges such as the complex political situation, governance, and the absence of an efficient administration to fully support the implementation of FD, the author does not explain further why this could be the cause of the lack of proper flood risk management in Indonesia. non-EU countries.

Issues regarding economic considerations and political complexity are important factors that influence and bring challenges as a form of implementation in the field. It's also a bit unfortunate in my opinion, the author does not discuss how the geographical shape of the cause of flooding in each country location is a separate determining factor why a flood disaster can occur in a location and cause a significant impact on the community.

Discussion

Research on policies and management from the government and the community towards flood disaster management needs to be carried out to determine the level of concern and willingness of the government and society to take mitigation and adaptation actions. It is hoped that by knowing the aspects of government and policies that regulate flood hazards in their implementation to protect the community and increase resilience from the impacts of climate change, improvement and integration programs of sustainable water management from various sectors become a necessity to reduce flood hazards. From the writings of Solomun et al. (2022) conducted a comparative comparison of policies in Europe against the EU (Portugal and Slovenia) and non-EU (Serbia and Bosnia & Herzegovina) groups. From this paper it is concluded that EU countries are more efficient in their implementation of FD. Weak economies and complex land governance administrations in non-EU countries are significant barriers to increased flood resilience.

Evaluation of the Indonesia Flood Management

Flood is a disaster that often occurs in Indonesia. During 2021, floods dominated as the most common disasters in Indonesia with 1794 incidents (Figure 3). Disasters caused by hydrometeorological factors tend to increase every year and cause casualties, damage infrastructure, and significantly disrupt the stability of the community's economy (BNPB, 2022).

Figure 3. Indonesia Disaster Infographic 2021 (Source: BNPB, 2022)

To date, specific regulations regarding flood control in Indonesia are still separate from the broad control of existing flood problems. The main law (UU) that regulates disaster problems in general, including flooding, is still one, namely Law Number 24 of 2007 concerning Disaster Management (Pemerintah Indonesia, 2007). The law regulates disaster management in general. One of them is in Article 54 which reads, "The handling of disaster-affected communities and refugees is carried out with activities including data collection, placement in safe locations, and meeting basic needs."

The following are some of the Laws and Regulations concerning Floods:

1. 1945 Constitution of the Republic of Indonesia.
2. Law of the Republic of Indonesia No. 11 of 1974 concerning Irrigation.
3. Law of the Republic of Indonesia No. 19 of 2004 concerning Forestry.
4. Law of the Republic of Indonesia No. 24 of 2007 concerning Disaster Management.
5. Law of the Republic of Indonesia No. 26 of 2007 concerning Spatial Planning.
6. Law of the Republic of Indonesia No. 27 of 2007 concerning the Management of Coastal Areas & Small Islands.
7. Law of the Republic of Indonesia No. 32 of 2009 concerning Environmental Protection and Management.
8. Presidential Regulation No. 8 of 2008 concerning the National Disaster Management Agency.
9. Regulation of the Minister of Public Works and Public Housing No. 4 of 2015 concerning the Determination of River Basin.
10. Regulation of the Minister of Public Works and Public Housing No. 26 of 2015 concerning River Channel Diversion and/or Utilization of Ex-River Sections.
11. Regulation of the Minister of Public Works and Public Housing No. 27 of 2015 concerning Dams.

12. Minister of Public Works and Public Housing Regulation No. 28 of 2015 concerning Stipulation of River Border Lines, and Lake Border Lines.

Floods are one of the natural disasters that always occur in various regions in Indonesia. Water Resources Management (SDA) including flooding cannot be limited by administrative areas, but natural resource management is limited by River Basin (WS) . In Indonesia, WS are divided into 5 WS across countries, 29 WSs across provinces, 29 WSs across national strategic areas, 53 WSs across districts/cities, and 15 WS districts/cities (BNPB, 2016). The causes of flooding include static natural conditions such as geography, topography, and river flow geometry. Dynamic natural events such as high rainfall, damming from the sea/tidal on the main river, subsidence, and siltation due to sedimentation as well as dynamic human activities such as inappropriate land use in floodplains, namely; establishment of settlements on riverbanks, lack of flood control infrastructure, subsidence of land and sea level rise due to global warming (Sastrodihardjo, 2010).

Reduction of flood risk is part of WAS-based natural resource management that must be planned and implemented in an integrated manner within a WS. In Indonesia, the strategy and policies must be in line with the existing regulations in Law no. 7 of 2004 in the form of physical and non-physical disaster prevention, disaster management, and recovery of conditions after a disaster. Various strategies in the form of physical and non-physical efforts are applied to overcome flood and drought problems in the form of land conservation, construction of water reservoirs (dams and reservoirs), river rehabilitation, and construction of polders. Reducing the risk of flood disasters is not only carried out with the construction and arrangement of building facilities and infrastructure, but also in accordance with Law no. 26 of 2007 concerning Spatial Planning, the Unitary State of the Republic of Indonesia (NKRI) which is located in a disaster-prone area requires spatial planning based on disaster mitigation as an effort to improve the safety and comfort of life and preserve the environment.

In the form of its implementation regarding flood management in Indonesia, Handayani et al. (2020) explain how one form of land use policy assessment and flood management is related to urbanization and the increased risk of flooding on the north coast of Central Java. Particular attention is paid to the potential impact of the relationship between watersheds and urbanization and flooding. It is generally known that "most cities have historically developed near rivers or oceans to meet their water needs" (Bae et al., 2019), so it is not surprising that Indonesia, a country surrounded by various water areas, has cities located near water area. The case study of Handayani et al. (2020) identifies possible changes in land use components to the global flood crisis. This statement is in line with the opinion that urbanization and lack of land use planning can increase the amount of flood exposure (Bae et al., 2019).

The author focuses on assessing land use change in 2009 – 2018 using Landsat images in four watershed areas, namely Pemali-Comal, Bodri-Kuto, Jratunseluna, and Wiro-Gelis. Non-spatial data such as rural-urban classification and flood events were analyzed using spatial data. Then it was found that urbanization, as shown by the growth of the built-up area, was very significant. The impact of flood exposure is in urban areas and areas that have the potential to become urban areas. The discussion that then emerged showed that watersheds have multiple spatial identities in urban systems including how existing policies and land use govern them. How land conversion occurred in 2009 – 2018 is shown in Figure 4.

The relationship between land use per watershed area and the incidence of flooding is explained in Figure 5. Jratunseluna, the largest watershed, experienced the highest number of floods compared to other watersheds. Flood events are concentrated in certain flood-prone areas, namely Pati Regency, Kudus Regency and Semarang City, all of which represent rural, potentially urban, and urban characteristics within the Jratunseluna watershed.

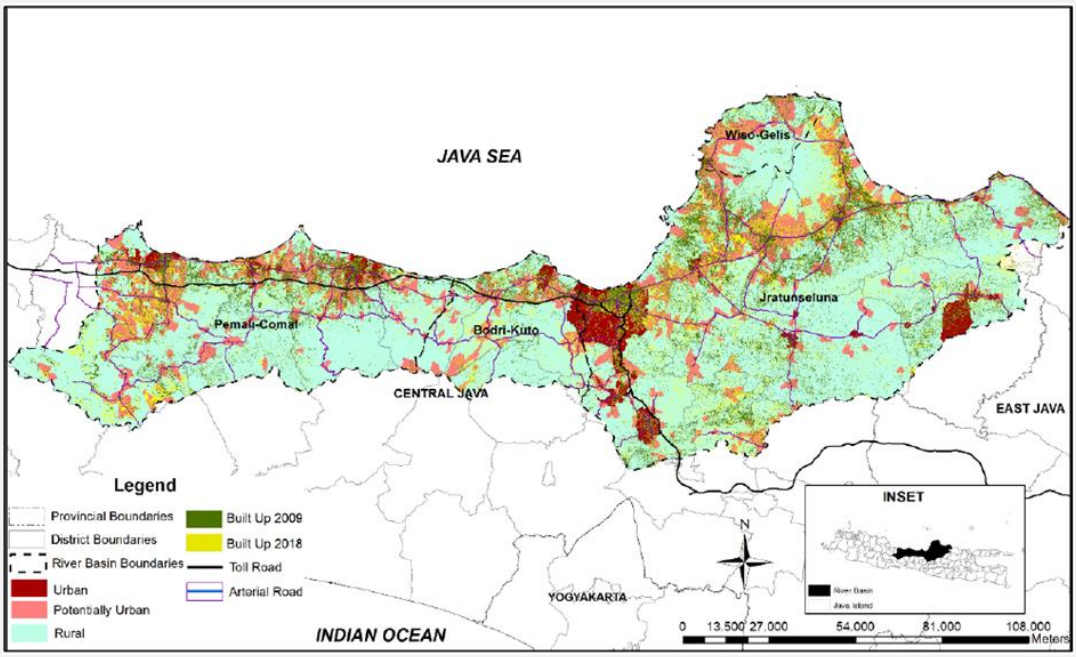

Figure 4. Changes in Watershed Land Use in 2009 – 2018 (Handayani et al., 2020)

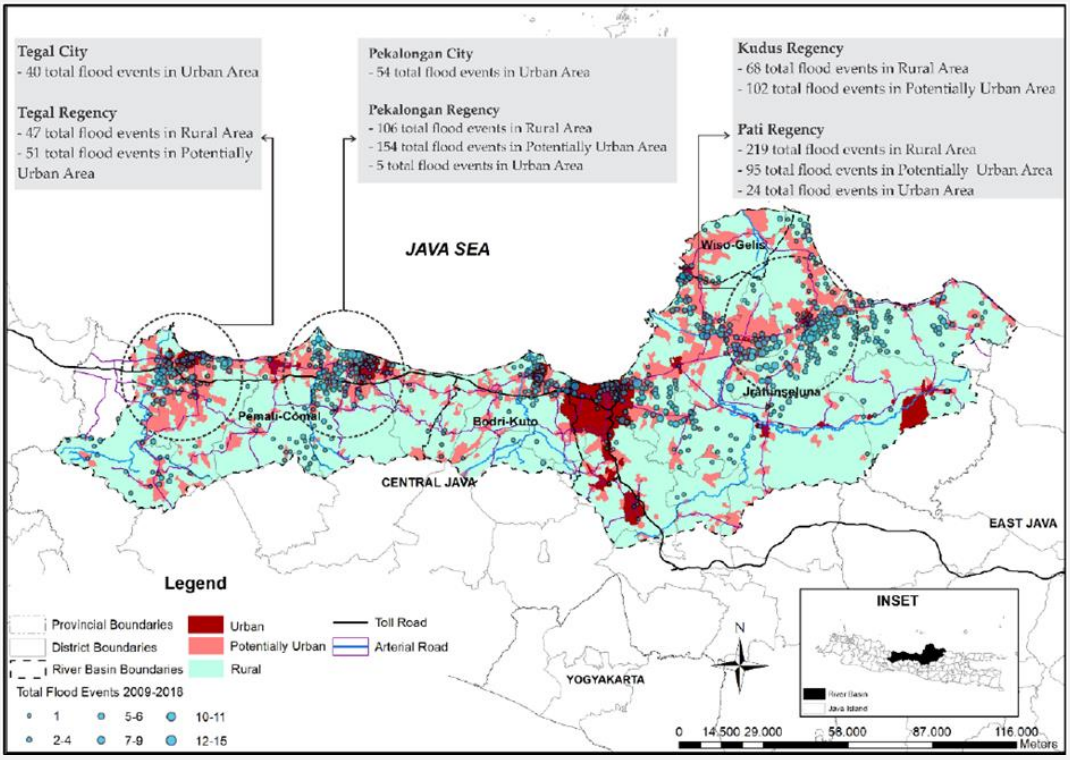

Figure 5. Urbanization and Flood Events in Watersheds Case Study (Handayani et al., 2020)

Land use change and flood phenomena are then discussed, the population of the case study area increased from 17.1 million people in 2009 to 18.3 million people in 2018. Significant flood exposure has occurred in urban areas and has the potential to become an urban area. urban areas

follow the built-up areas. The impact of fluvial flooding also has a significant impact on rural and urban areas.

Handayani et al. (2020) then raised two topics for discussion that the results that emerged from their research had several implications for the development of urban areas and their policies. First, the need to create a better understanding of urbanization and flood phenomena, to raise awareness that is more solution-oriented through land use policies. Second, there is a need to identify the role of governance in flood management, particularly in addressing urban flooding. From these two topics, it was further discussed that watersheds have a dual spatial identity in the form of policy issues and urban land use systems and how there are several opportunities to expand the role of governance in flood management for the government. This is illustrated in Figure 6.

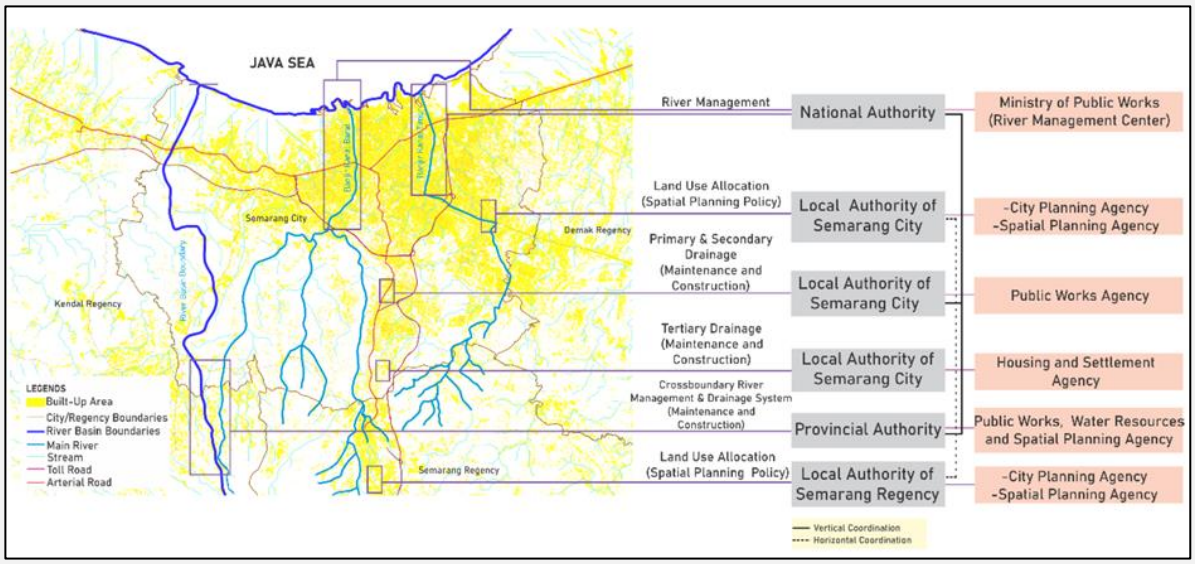

Figure 6. Roles and Responsibilities Related to River Management and Land Use Allocation (Handayani et al., 2020)

Indeed, there is a government responsibility to provide public infrastructure to reduce flood events. Provision of infrastructure requires not only technical and financial capacity but also appropriate coordination between different government agencies. Disaster risk reduction through appropriate land use planning and control is an important instrument for securing urban areas (such as the case study area, and the entire island of Java in Indonesia) (Handayani et al., 2020)

CONCLUSION

Perceptions of future flood management and control policies require serious attention from various lines, especially within the government as policy makers and the community as implementers in the field. Based on the reviews that have been carried out, several main conclusions are obtained, namely:

a. Countries in Europe are obliged to implement directives on a national scale, by implementing PFRA for riverine and coastal areas, to identify areas at risk of having high flood potential based on past events, mapping flood hazard and flood risk in each area, and determine a set of measures to reduce the occurrence of flooding and prioritized based on costs and benefits. In practice, countries such as Portugal and Slovenia which are members of the European Union are efficient in carrying out these directives.
b. In a comparison of EU and non-EU countries such as Serbia and Bosnia & Herzegovina, it is found that weak economies and complex government administrations are significant barriers to increased flood resilience. This can be seen from the complicated political situation of Serbia

and Bosnia & Herzegovina, where the danger of natural disasters such as flooding is of secondary importance.

c. Disaster risk reduction through appropriate land use planning and control for case studies such as flooding in Indonesia, provides an opportunity to maintain settlements in coastal and archipelagic areas that may face complex environments such as extreme rainfall or associated disasters and hydrometeorological hazards. However, without proper management measures, technical measures are not sufficient to improve the existing situation. Governance in flood management is very important. This aspect is the missing link in risk management strategies in urban environments in Indonesia.

d. Learning from the implementation of flood management and control (FD) in Europe and how the example of case studies in Indonesia, flood management and control must be carried out in a comprehensive, structured, and carried out jointly by all lines in order to achieve goals efficiently.

REFERENCES

Adamson, M. (2018). Flood risk management in Europe: The EU 'Floods' directive and a case study of Ireland. *International Journal of River Basin Management*, *16*(3), 261-272. https://doi.org/10.1080/15715124.2018.1437744

Bae, S., & Chang, H. (2019). Urbanization and floods in the Seoul Metropolitan area of South Korea: What old maps tell us. *International Journal of Disaster Risk Reduction*, *37*, 101186. https://doi.org/10.1016/j.ijdrr.2019.101186

Bissolli, P., Friedrich, K., Rapp, J., & Ziese, M. (2011). Flooding in eastern central Europe in May 2010-reasons, evolution and climatological assessment. *Weather*, *66*(6), 147-153. https://doi.org/10.1002/wea.759

BNPB. (2016). *Indonesia Disaster Risk Book*. Jakarta.

BNPB. (2022). Disaster Event in 2021. https://bnpb.go.id/infografis/Genesis-bencana-tahun-2021

Dwirahmadi, F., Rutherford, S., Phung, D., & Chu, C. (2019). Understanding the operational concept of a flood-resilient urban community in Jakarta, Indonesia, from the perspectives of disaster risk reduction, climate change adaptation, and development agencies. International journal of environmental research and public health, 16(20), 3993. https://doi.org/10.3390/ijerph16203993

European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2017). *Overview of natural and man-made disaster risks the European Union may face*, Publications Office. https://doi.org/10.2795/861482

European Environment Agency (EEA). (2016). *Flood risks and environmental vulnerability : exploring the synergies between floodplain restoration, water policies and thematic policies*, Publications Office. https://doi.org/10.2800/039463

FAO. (2020). *Comprehensive analysis of disaster risk reduction and management system for agriculture in Bosnia and Herzegovina*. Sarajevo. https://doi.org/10.4060/ca7914en

Handayani, W., Chigbu, U. E., Rudiarto, I., & Putri, I. H. S. (2020). Urbanization and Increasing Flood Risk in the Northern Coast of Central Java—Indonesia: An Assessment towards Better Land Use Policy and Flood Management. *Land*, *9*(10), 343. https://doi.org/10.3390/land9100343

Hladnik, D. (2005). Spatial structure of disturbed landscapes in Slovenia. *Ecological Engineering*, *24*(1-2), 17-27. https://doi.org/10.1016/j.ecoleng.2004.12.004

Ionita, M. (2015). Interannual summer streamflow variability over Romania and its connection to large-scale atmospheric circulation. *International Journal of Climatology*, *35*(14), 4186-4196. https://doi.org/10.1002/joc.4278

Ionita, M., Dima, M., Lohmann, G., Scholz, P., & Rimbu, N. (2015). Predicting the June 2013 European flooding based on precipitation, soil moisture, and sea level pressure. *Journal of Hydrometeorology*, *16*(2), 598-614. https://doi.org/10.1175/JHM-D-14-0156.1

Ionita, M., Nagavciuc, V., & Guan, B. (2020). Rivers in the sky, flooding on the ground: the role of atmospheric rivers in inland flooding in central Europe. *Hydrology and Earth System Sciences*, *24*(11), 5125-5147. https://doi.org/10.5194/hess-24-5125-2020

Leal, M., Fragoso, M., Lopes, S., & Reis, E. (2020). Material damage caused by high-magnitude rainfall based on insurance data: Comparing two flooding events in the Lisbon Metropolitan Area and Madeira Island, Portugal. *International Journal of Disaster Risk Reduction*, *51*, 101806. https://doi.org/10.1016/j.ijdrr.2020.101806

Mikoš, M. (2020). Poplavna nevarnost v Sloveniji in ocena ekstremnih projektnih poplavnih pretokov. *Acta hydrotechnica*, *33*(58), 43-59. https://doi.org/10.15292/acta.hydro.2020.04

Pemerintah Indonesia. (2007). Undang-Undang Republik Indonesia Nomor 24 Tahun 2007 Tentang Penanggulangan Bencana. Tambahan Lembaran Negara Republik Indonesia Nomor 4723. http://idmf.id/files/snapshot/UU%2024%202007.pdf

Peña-Angulo, D., Nadal-Romero, E., Gonzalez-Hidalgo, JC, Albaladejo, J., Andreu, V., Bagarello, V., Barhi, H., Batalla, R.,. J., Bernal, S., Gienes, R., Campo, J., Campo-Bescos, MA, Canatario-Duarte, A., Canton, Y., Casali, J., Castillo, V., Cerdà, A., Cheggour, A., Cid, P., Zorn, M. (2019). Spatial variability of the relationships of runoff and sediment yield with weather types throughout the Mediterranean basin. *Journal of Hydrology, 571*, 390–405. https://doi.org/10.1016/j.jhydrol.2019.01.059

Ristic, R., Kostadinov, S., Abolmasov, B., Dragicevic, S., Trivan, G., Radi_c, B., Trifunovic, M., & Radosavljevic, Z. (2012). Torrential floods and town and country planning in Serbia. *Natural Hazards and Earth System Sciences, 12*, 23–35. https://doi.org/10.5194/nhess-12-23-2012

Santos, P. M. P. (2015). Cheias e inundações: avaliação, impactos e instrumentos para a gestão do risco. Portuguese. https://repositorio.ul.pt/handle/10451/22720

Sastrodihardjo, S. (2010). *Upaya mengatasi masalah banjir secara menyeluruh*. Yayasan Badan Penerbit Pekerjaan Umum, Mediatama Saptakarya.

Solomun, M. K., Barger, N., Cerda, A., Keesstra, S., & Marković, M. (2018). Assessing land condition as a first step to achieving land degradation neutrality: A case study of the Republic of Srpska. *Environmental Science & Policy*, *90*, 19-27. https://doi.org/10.1016/j.envsci.2018.09.014

Solomun, M. K., Ferreira, C. S. S., Barger, N. N., Tošic, R., & Eremija, S. (2020). Understanding the role of policy framework on land degradation in stakeholder's perception from a post conflict perspective of Bosnia and Herzegovina. *Land Degradation and Development, 32*, 1–10. https://doi.org/10.1002/ldr.3744

Solomun, M. K., Ferreira, C. S. S., Zupanc, V., Ristić, R., Drobnjak, A., & Kalantari, Z. (2022). Flood legislation and land policy framework of EU and non-EU countries in Southern Europe. *Wiley Interdisciplinary Reviews: Water*, *9*(1), e1566. https://doi.org/10.1002/wat2.1566

Špitalar, M., Brilly, M., Kos, D., & Žiberna, A. (2019). Analysis of flood fatalities–Slovenian illustration. *Water*, *12*(1), 64. https://doi.org/10.3390/w12010064

Stevens, A. J., Clarke, D., & Nicholls, R. J. (2016). Trends in reported flooding in the UK: 1884–2013. *Hydrological Sciences Journal*, *61*(1), 50-63. https://doi.org/10.1080/02626667.2014.950581

Terêncio, D. P. S., Fernandes, L. F. S., Cortes, R. M., Moura, J. P., & Pacheco, F. A. (2020). Flood risk attenuation in critical zones of continental Portugal using sustainable detention basins. *Science of the Total Environment*, *721*, 137727. https://doi.org/10.1016/j.scitotenv.2020.137727

WHO. (2017), Flooding: Managing Health Risks in the WHO European Region; World Health Organisation Regional Office for Europe: Copenhagen, Denmark; ISBN 978-9-28905-279-5. https://apps.who.int/iris/handle/10665/329518

WMO. (2004). Floods. https://public.wmo.int/en/our-mandate/water/floods