Community Resilience in Adaptive Flood Mitigation Based on the Local Wisdom of Silat Village in the Kapuas Watershed Indonesia

Henny Herawati[1(✉)], Kartini[1], Eko Yulianto[1], Rima Wahyu Utari[2], and Dini Ariva[3]

[1] Departement of Civil Engineering, Faculty of Engineering, Universitas Tanjungpura, Pontianak, Indonesia
hennyherawati@civil.untan.ac.id

[2] Fluid Mechanic and Hydraulic Laboratory, Faculty of Engineering, Universitas Tanjungpura, Pontianak, Indonesia

[3] Departement of Environmental Engineering, Faculty of Engineering, Universitas Tanjungpura, Pontianak, Indonesia

Abstract. Silat village is a village upstream of the Kapuas River, which is the longest river in Indonesia. One of the tributaries of the Kapuas River is the Silat River. The history of population distribution on the island of Kalimantan, especially West Kalimantan is through water transportation, this condition leads us to the plausibility if the location of residential areas is on the banks of rivers. This causes residential areas to often experience flooding when river water discharge increases. In the last 30 years, there has been the development of the plantation sector around the Silat village area. Types of plantations include rubber and oil palm plantations. This condition causes a reduction in the area of primary forest by 8.3% of the total Silat watershed area. The impact of this land cover change causes the frequency of floods that occur to increase. Flood control efforts by the government with adequate infrastructure development have not been carried out optimally. Therefore it is necessary to do mitigation by the community itself. Mitigation by the community is emphasized on efforts to increase the community's ability to be anticipatory, and be adaptive to flood disasters. Efforts to increase community resilience to floods involving community participation need to be carried out through education while still adapting to local knowledge or local wisdom in the area. The ability to adapt creates the endurance for the community itself, in doing the mitigation towards the upcoming flood. This community resilience can be achieved through collaboration from various parties such as the government, stakeholders, and the general public. To enchance the community resilience through education. Education efforts need to be carried out continuously in the delivery of environmental conservation information and knowledge about floods and their causes, as well as the mitigation efforts. Education is carried out to all levels of society, starting from children, teenagers, adults, both women and men.

Keywords: Community Resilience · Mitigation · Flood · Adaptive · Local Wisdom

© The Author(s) 2023
A. Doyan et al. (Eds.): ICSES 2022, APR 8, pp. 46–59, 2023.
https://doi.org/10.2991/978-94-6463-232-3_6

1 Introduction

West Kalimantan Province is located on the island of Borneo, with an area of 147,307 square kilometers [1]. West Kalimantan Province is crossed by many rivers. The main river which crossed some areas in the district and cities in West Kalimantan Province is Kapuas River. Kapuas River is the longest river in Indonesia with a length of 1.143 square kilometers [2]. It is the main source of life for the people who lived in the river coast of Kapuas River. Kapuas River became the clean water source to supply the community main needs such as bath, washing, and as their livelihood.

In the era before the 20th century, the transmigration, transmission, and the mobilization of population uses the water transportation modes. Those transmigration will estabilished a life structure which turning an uninhabited area to the habited ones and built a settlement to live. The water transportation access caused the existence of settlement location around the coast river of Kapuas River. After the 20th century, which already has an adequate available ground transportation, leads to the movement of population to the further location from the river pass. Nonetheless, it doesn't change the location of the central government is still around the river.

Geographically speaking, the central government of district and the sub district are abroad along the Kapuas River and its tributary. That district comprises of Kapuas Hulu Regency, Sintang Regency, Melawi Regency, Sekadau Regency, Sanggau Regency, Landak Regency, Kubu Raya Regency and Pontianak City. Kapuas Hulu Regency is a district that is located at the upper reaches of the Kapuas River and disembogue around Pontianak City. The watershed map of the Kapuas River can be seen in Fig. 1. Silat Village is one of the Village in Kapuas Hulu Regency. Silat Village centralize on the banks of the Kapuas River and at the confluence of the Kapuas River and its tributary, the Silat River. The banks of the Silat River developed into residental areas.

As an area which lived around the main river banks, the Kapuas River and on the Silat tributary meeting point, it leads to the frequently flood that hits the Silat Village. Flood in the Silat Village occurs when it rains in the upper Kapuas River and Silat River. This flood condition has been happened from time to time, on the contrary before the 20th century. Therefore, the local community have known about this flood conditions since long time ago. Various anticipatory activities have been carried out with the type of adaptive housing structure, such as construction of houses on stilts and houses built on the surface of the water known as "Lanting". The figure of the stilts house (Fig. 1). The condition of the stilts house when the flood was happened in the Silat Village can be seen in Fig. 2. The figure of Lanting (houses built on the surface of the water) can be seen in Fig. 3.

With the increases of population and development of construction creates an inevitability that a life style changes from the community might occurs. The land transportation has dominated. This caused to the unavoidable actions which is land clearing to fulfill various needs. The community livelihood that was originally centered on the river in freshwater fishing or farming around rivers, has shifted into make a living on the plains, like a farmer with shifting farming systems or as casual labourers. The land clearing of forest begins to spread out. Agriculture with shifting cultivation has gradually turned into plantation areas. This causes changes in land cover types on a wider scale.

(a) (b) (c)

Fig. 1. Houses on stilts in Silat Desa Village ((a) The view of the house from the front (b) The pillars of the house above the ground level of more than 1 m (c) The perspective of the house view.

(a) (b)

Fig. 2. House on stilts when there was a flood in Silat Village (a) The condition when the flood inundated the village, the flood water level did not reached the floor of the house (b) Temporary bridge was built to connect from house to house

(a) (b)

Fig. 3. Lanting in Silat Village (a) lanting position when there is no flood and (b) Lanting position when flood occurs

The pattern of land cover changes which has happened in the past 30 years was followed by the increasing of flood intensity and the flood heights that occurred in Silat Village [3]. This shows an intercourse between the reduced land cover and flooding that occurred in Silat Village. Changes in land cover that occur could directly transform the hydrological properties of an area by reducing the infiltration rate, baseflow, and lag time as well as increasing surface runoff, peak discharge, runoff volume and flood frequency [4]. Changes in land cover can also affect the frequency and characteristics of rain [5].

This escalation in flood intensity causes losses to the community. To reduce the losses that occured, of course, it needs to be accompanied by maximum efforts to mitigate disasters for the community. Due to geographical and economic reasons, it cannot rely solely on the efforts of the government alone. The government cannot afford to develope an adequate infrastructure in all places as a whole, due to the limited financing available. Hence why it is necessary to carry out mitigation efforts by the community itself.

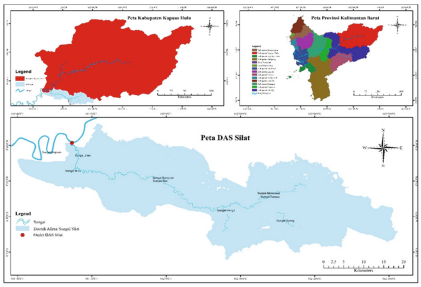

Fig. 4. Silat watershed is a sub-watershed of Kapuas

The mitigation efforts by the community can be carried out if the community has an adequate capability and knowledgable to flood mitigation efforts. The efforts to increase community resilience towards floods involving the community participation need to be carried out through education while still adapting the local knowledge or local wisdom in that area. Therefore, the purpose of this article is to analyze what kind of efforts and knowledge are needed by the community and how to increase the resilience of the community.

2 Method

2.1 Location

This research was done in Silat Village, Kapuas Hulu Regency. The maps of location can be seen in Fig. 4. The confluence of the Kapuas River and Silat River can be seen in Fig. 5. In Fig. 5 it shows the position of residential areas on the river bank, both the Kapuas River and the Silat River are at normal water discharge conditions.

This paper written based on research that has been done through survey, observation, and analysis of settlement conditions and flood conditions that occurred in the recent years. The flood analysis was carried out by hydrological analysis using the data which was obtained from rain observation stations around the Silat Village. The land cover data was obtained from the secondary data from related agencies.

2.2 Materials

Based on the rainfall data from the BMKG Supadio station, the average annual rainfall is 53 years (1968–2020) is 3.210 mm. The upper limit value is 3,708 mm and the lower limit value is 2,695 mm. As a comparison, the rainfall data from a downloaded satellite data is also used from the TRMM for Kapuas Hulu sub-watershed until its outlet point is at the mouth of the Silat River. In particulary to obtain the average rainfall in the Silat watershed, the area that was used took on the grid number 46, 55, 56, and 57. The TRMM Grid distribution map can be seen in Fig. 6.

The rain station that has the longest data record is the BMKG Supadio station. This station is located around Pontianak City or in the mouth of the Kapuas River. The rain conditions based on the BMKG Supadio station reviewed on 50 years of rain data, that is

namely the annual rain trend that occurs has decreased with the equation y = −1.9736x + 7062.3. Meanwhile, the average for 5 years (moving averages) has increased with the equation y = 2.8316x + 2515. From the analysis, it is known that the rain that has occurred for 53 years has decreased by about 2 mm per year. The graph of the annual rainfall conditions of the BMKG Supadio station for 1970–2020 can be seen in Fig. 7.

Silat village is one of the villages in the Kapuas Hulu district, which is the most upstream part of the Kapuas River. The data used for flood hydrograph analysis in this study is the rain data from BMKG Pangsuma in Putussibau. The use of rain data from the Pangsuma BMKG station with the assumption that the water discharge depicted on the flood hydrograph at the outlet point at the mouth of the Silat River comes from the upper reaches of the river, in this case water from Putussibau and its surroundings.

From the maximum rainfall data for 1 day at the BMKG Pangsuma station in Putussibau, it is known that there has been an increase in the amount of rain with an increasing trend of rain for the last 23 years (1998–2020). This increase in rainfall follows the equation; y = 0.276x + 131. With a value of R2 = 0.0044. This equation shows that there is an increase in the maximum 1-day rainfall measured at BMKG Pangsuma in Putussibau by 0.3 mm every year.

Fig. 5. Photo of the confluence of the Kapuas River and the Silat River (a) View of the Kapuas River (b) View of the confluence of the Silat River

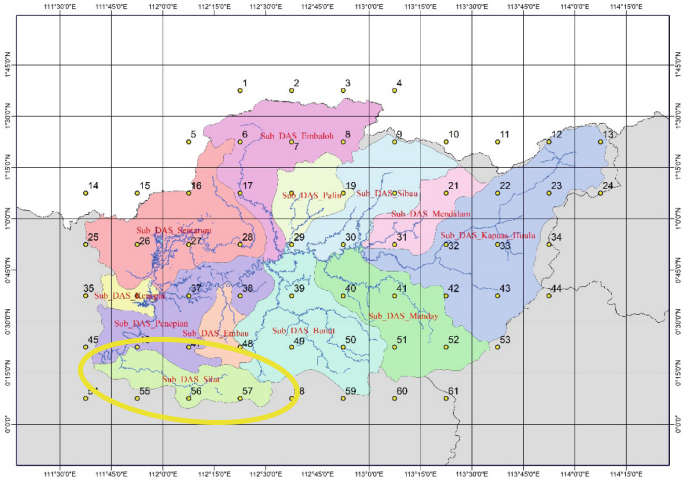

Fig. 6. Rainfall Based On Trmm Grid Grid Number

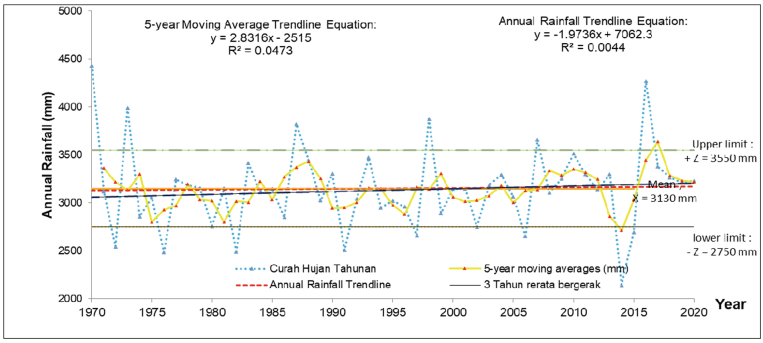

Fig. 7. Annual Rainfall at Supadio BMKG Station 1970–2020 (Supadio, 2020)

By the occurence of increased rainfall and with changes in the type of land cover around the Silat river, the efforts that can be made to increase community resilience need to be analyzed. The analysis was carried out by means of literature studies and field surveys, by studying the information and conditions of the local community.

3 Results and Discussion

3.1 The Flood Potential in Kapuas Watershed

The watershed of the Kapuas river has a large discharge ranging from 3,200 m3/s [2, 6–8]. The Silat Village is located in the upper reaches of the Kapuas River, where there is a tributary, known as the Silat River. The Kapuas and Silat Rivers' condition can be seen in Fig. 5. The activities of the people who lives on the banks of the river is focused on activities in the river. For bathing and washing activities were done at home on the water or called lanting. The form of lanting can be seen in Fig. 3 and Fig. 8. The lanting position will be adjusted to the water level where the lanting was built. Even when it comes to flood, lanting will adjust the water level elevation. Because lanting will floating on top of the water surfaces. So as when the flood is come, lanting will neither experiencing inundation or drowned.

Flood is a condition in which water is not accommodated in the drain channel (river trough) or the flow of water is obstructed in the waste channel, thus overflowing the surrounding area (flood plain) [2, 8]. One of the causes of flooding is the destruction of

Fig. 8. The condition of the Kapuas River and the house on the water (Lanting)

forests. The loss of natural vegetation such as illegal logging of trees will disrupting the hydrological cycle so that flood might occurs [9].

One of the hydrological components affected by land use changes in the watershed is the runoff coefficient (C). The runoff coefficient (C) is a number that expresses the ratio between the amount of runoff to the amount of rainfall. A small value (C) indicates to the condition of the watershed is decent and vice versa if the value (C) is large, it indicates to the watershed has been damaged. The main factor which affected C is the rate of soil infiltration or the percentage of impervious land, land slope, cover crops and rainfall intensity. The value of C changes from time to time according to surface flow in the river, especially the soil moistures. The runoff coefficient (C) can be estimated by reviewing the land use [10].

3.2 The Condition of the Silat River Watershed

The banks of the Silat River has developed into residential areas, while the factors that can affect river flow into residential areas include: a) rivers as an effective transportation route to the outside world or vice versa; b) rivers as a source of livelihood (agriculture, forest products, etc.) the function of rivers like this is mostly located in the upstream area, while in the middle and downstream it is more used as a means of transportation and fisheries because the land is swampy; c) at the mouths of rivers where diverse communities meet so that this condition makes it possible for people to live and increase the interactions with the outside world [11].

Based on the land cover map in the Silat watershed, it can be seen that during the last 30 years there has been significant changes in the type of land cover. The area of each type of land cover in 1990, 2000, 2011 and 2020 can be seen in Table 1.

Based on the results of the analysis of land cover types in the Silat watershed, it is known that there has been changes in the type of land cover over the last 30 years. Changes

Table 1. The area of land cover in the Silat watershed

ID			**Luas Areal (Ha)**		
	Types of Land Cover	Year .1990	Year .2000	Year .2011	Year .2020
2001	Primary dry land forest	5,122	3,998	3,902	3,747
2002	Secondary dry land forest	68,045	65,654	61,558	57,755
2007	Shrubs	2	3,440	4,869	5,643
2010	Plantation	7,270	7,270	10,907	14,955
2014	Open ground	1,647	1,660	240	541
5001	Water body	613	615	615	614
20051	Secondary swamp forest	46	46	46	46
20092	Mixed dry land farming	58,278	58,339	58,887	57,722
20141	Mining	52	52	52	52
	Total	141,075	141,075	141,075	141,075

in this type of land cover affect the changes in the characteristics of the Silat watershed. Changes in watershed characteristics might affect the amount of the flood hydrograph according to the calculated return period. Rivers as the source of livelihood, especially for fisheries, agriculture, plantations and forest products have grown rapidly on the banks of the Silat River in the last 30 years. The types of plants which has developed are quite a lot including rubber and oil palm plantations. This condition causes a reduction in primary forest area of 8.3% (141,075 hectares) of the total Silat River watershed. The impact of this land cover change causes the frequency of flooding to increase.

This increase in flood intensity causes losses to the community. Losses that occur directly or indirectly to the community include social, economic, and environmental impacts. The flood causes physical damage to the affected areas such as damage to public infrastructure, community-owned houses and agricultural land. This damage, of course, causes economic losses for the community. Floods also contribute to ecological damage to animals and plants and cause soil pollution in the form of contamination of soil and water with hazardous substances due to improper drainage systems and the emergence of diseases that can become epidemics for the community. Besides the physical losses, floods also have a psychological impact on the people who experience them, this psychological pressure could evoked from losses due to floods that occur such as losing their homes, losing their livelihoods, losing family members [12].

Flood management activities generally consist of three elements, namely mitigation, response and recovery [13]. Disaster mitigation is a series of efforts to reduce disaster risk through physical development, awareness and capacity building to deal with threats. Flood disaster mitigation can be done with a non-structural approach, namely actions that do not only involve physical, construction but also use knowledge, practices, or agreements to minimize risks and impacts, policies and laws, public awareness, training, and especially education [14].

To reduce the losses that occur, of course, it needs to be accompanied by maximum efforts to carry out disaster mitigation in the community. Due to geographical and economic reasons, it cannot only rely on the efforts of the government alone. The government has not been able to carry out an adequate infrastructure development in all places as a whole, due to the limited funding available. Therefore, it is necessary to carry out mitigation efforts by the community itself. Providing education about disaster mitigation to the community can be done by incorporating elements of local wisdom adapted by the community. Education to the community plays an important role in increasing the community resilience because it relates to informing the community's understanding of the ways in which they cope, adapt, and change a situation to deal with flood disasters [15]. Involving the community in a participatory manner in disaster mitigation can improve community resilience in the face of future floods [16].

The efforts to control flow also need to be carried out by conducting the river storage capacity studies. The study of river storage capacity is studied by knowing the amount of sedimentation in the Silat river. This needs to be done to ensure whether the holding capacity of the Silat river is able to accommodate the flood discharge that occurs in the catchment area or is able to accommodate the rain that occurs in the Silat watershed. Especially when there is extreme rain at a certain return period, the Silat river still has sufficient capacity to accommodate and drain water from the Silat river to the Kapuas

Fig. 9. Condition of Silat River, Documentation 18 March 2021

River. The condition of the Silat River and residential areas on the banks of the Silat River can be seen in Fig. 9 and Fig. 10.

The existences of residential houses around the river can be seen in Fig. 11 and Fig. 12. Connecting facilities to across the channel or the so-called ditch using a bridge, see Fig. 13. The height of the bridge was made high, because the channel or ditch is used by the community as a water transportation channel. Water transportation is as shown in Fig. 9. From the illustration, the community has had resistance to flood hazards for generations.

Fig. 10. Settlements are on the banks of the Silat River

(a) (b)

Fig. 11. Seen from above the position of housing is on the outskirts of the Kapuas River (a) The condition of the Kapuas River around the Silat Village (b) the presence of lanting and people's houses on the edge of the Kapuas River

Fig. 12. Water level elevation and housing on the outskirts of the Kapuas River

Fig. 13. The elevation of the bridge is made high on the channel that is used as a water transport channel

3.3 The Efforts to Anticipate Flood Disasters by the Community in a Participatory Manner

By the existence of the enchancement from the community's economic level, slowly this water transportation has begun to be abandoned due to its long duration and costs higher. So most people no longer use water transportation as the main means of transportation. The spread of settlements extends to the higher areas. However, most of the indigenous people still live around the river. With the change in global climate, where the intensity of rain events is relatively increasing with a relatively short duration, the danger of flooding often occurs.

In the span of 2020 to 2022, was dominated by the extreme weather with high rainfall for a long duration, that an inevitable flood condition occured. Many community activities have stopped. This makes it very difficult for the community to carry out their lives.

The government's efforts in anticipating the disasters, especially flood prevention, have not yet to be carried out in all regions. The efforts have only reached the district level, but have not yet reached the sub-district or village level. Therefore, it is necessary to make a participatory effort [17]. Communities need to have the ability to deal with flood problems independently.

The participatory efforts can be made if the community has sufficient skills and knowledge. With the knowledge and skills they have, they can solve their own problems.

Fig. 14. Water motor and piston for anticipating flood events by placing house furniture on lanting

Knowledge of the average elevation of the front of the house to avoid the monthly flooding. Or knowledge of how to adapt to natural conditions and how to have resilience to global climate change.

From the research for information in the field, the following are obtained:

1. Local people are used to building houses with a stilt system, so that when flood water hits the land, the house is still safe.
2. In the past, people built their house on floating water, which the people called lanting. So that if the river water level is high, the house still floating on the water, it will neither got flooded or drowned. Houses like this are hard to find. The only remaining lantings are the small ones, which are only used for activities such as bathing, or as a means of crossing to dock canoes or water motors (steher) see Fig. 14.
3. When the water is high and inundates the ground surface, the community will build temporary bridges to connect from house to house.
4. This flood prevention activity is carried out by the community collectively called as mutual cooperation. This togetherness is felt in the midst of the Silat Village community. This is the initial capital in participatory countermeasures.

3.4 The Community Resilience Efforts in Flood Mitigation

From the information obtained, it is necessary to make efforts to regrow the forms of local cultural activities in order to increase community resilience towards flood disasters in a participatory manner [18]. Counseling and socialization need to be improved. Education to the community needs to be carried out continuously in order to achieve the sustainability.

To carry out mitigation, it is necessary to strengthen the education/literacy to increase the community resilience towards floods. Some of the local cultures that still exist, such as making high-rise buildings to avoid flooding, need to be revived. When there is a flood, people build a stage or bridge to put furniture to avoid puddles, this condition can be seen in Fig. 15.

There are many participatory mitigation activities that can be carried out by the community. Disaster mitigation based on local wisdom can be carried out both in flood and drought management [18].

This community resilience can be achieved through collaboration from various parties such as the government, stakeholders, and the general public. Community resilience could be increased through the public education activities. Education efforts need to be

(a) (b)

Fig. 15. Anticipation of flood events by adjusting the placement of furniture in the house (a) when the river water level is normal and (b) furniture is placed on the stage when the water is flooded.

carried out continuously in the delivery of environmental conservation information and knowledge about floods and their causes, as well as mitigation efforts. Education is carried out to all levels of society, starting from children, adolescents, adults, both women and men. This adaptability creates a resilience for the community itself, in mitigating the floods that occur.

4 Conclusion

Based on the results of the analysis of land cover types in the Silat watershed, it is known that there has been a change in the type of land cover over the last 30 years. The government's efforts in anticipating disasters, especially flood prevention, have not yet to be carried out in all regions. Participatory efforts can be made if the community has skills and knowledge that are sufficient. With the knowledge and skills possessed, the community can solve their own problems.

Community resilience towards floods can be realized by involving the community in a participatory manner in flood disaster management. One way that can be done to minimize the risk of flood disasters is to provide education to the community which contains the local wisdom that has been adapted by the community. The ability to adapt and knowledge about minimizing the impact and how to prevent flooding creates resilience for the community itself, in mitigating the floods that occur.

To carry out the mitigation, it is necessary to strengthen education/literacy to increase the community resilience towards floods. Some of the local cultures that still exist, such as making high-rise buildings to avoid flooding. When there is a flood, people will build a stage or bridge to put furniture to avoid puddles. It is necessary to continue to provide counseling about the average elevation of the house floor elevation to avoid monthly flooding. Education in the form of counseling is carried out to all levels of society, starting from children, adolescents, adults, both women and men.

Acknowledgment. Thank are conveyed to all parties who have assisted in the completion of this research, to be specific the community in Silat Village. Especially to the head of the silat village who has helped coordinates with the community when the survey was carried out. Thank are also conveyed to The Dean of the Faculty of Engineering at the University of Tanjungpura who has assisted in financial support in completing the research. Thank are also conveyed to the reviewer team who provided input to make this article.

References

1. BPS Provinsi Kalimantan Barat, "Provinsi Kalimantan Barat Dalam Angka 2021," Pontianak, Kalimantan Barat, 2021.
2. H. Herawati, Suripin, Suharyanto, and Tia Hetwisari, "Analysis of River Flow Regime Changes Related to Water Availability on The Kapuas River, Indonesia †," Irrig. Drain., vol. 67, no. S1, pp. 66–71, 2018.
3. H. Herawati, Kartini, and E. Yulianto, "Pengaruh Perubahan Tutupan Lahan Terhadap Hidrograf Banjir Di Daerah Aliran Sungai (DAS) Silat Subdas Kapuas," Pontianak, Kalimantan Barat, 2021.
4. B. Tellman, J. E. Saiers, and O. A. R. Cruz, "Quantifying the impacts of land use change on flooding in data-poor watersheds in El Salvador with community-based model calibration," Reg. Environ. Chang., vol. 16, no. 4, pp. 1183–1196, 2016, https://doi.org/10.1007/s10113-015-0841-y.
5. D. Mitsova, "Coupling land use change modeling with climate projections to estimate seasonal variability in runoff from an urbanizing catchment near cincinnati, Ohio," ISPRS Int. J. Geo-Information, vol. 3, no. 4, pp. 1256–1277, 2014, https://doi.org/10.3390/ijgi3041256.
6. H. Herawati and F. T. P. Wigyarianto, "Suitability of Artificial Neural Network Application to Predict Sekayam River Discharge in Indonesia," vol. 22, no. 2, pp. 313–317, 2020.
7. H. Herawati, Suripin, and Suharyanto, "Impact of Climate Change on Streamflow in the Tropical Lowland of Kapuas River , West Borneo , Indonesia," Procedia Eng., vol. 125, pp. 185–192, 2015, https://doi.org/10.1016/j.proeng.2015.11.027.
8. H. Herawati, Suripin, and Suharyanto, "River flow modeling using artificial neural networks in Kapuas river, West Kalimantan, Indonesia," AIP Conf. Proc., vol. 1903, 2017, https://doi.org/10.1063/1.5011620.
9. L. Sebastian, "Pendekatan Pencegahan Dan Penanggulangan Banjir (Flood Prevention and Control Approach)," Din. Tek. Sipil, vol. 8, no. 2, pp. 162–169, 2008.
10. R. J. Kodoatie and R. Sjarief, Pengelolaan Sumber Daya Air Terpadu. Yogjakarta: Andi Offset, 2005.
11. Y. D. Purmintasari and Y. Kusnoto, "Pemukiman awal sungai Kapuas," SOCIA J. Ilmu-Ilmu Sos., vol. 15, no. 1, pp. 71–78, 2018, https://doi.org/10.21831/socia.v15i1.22013.
12. R. I. Hapsari and M. Zenurianto, "View of Flood Disaster Management in Indonesia and the Key Solutions," Am. J. Eng. Res., no. 5, pp. 140–151, 2016, [Online]. Available: www.ajer.org
13. K. Kaku and A. Held, "Sentinel Asia: A space-based disaster management support system in the Asia-Pacific region," Int. J. Disaster Risk Reduct., vol. 6, pp. 1–17, 2013, https://doi.org/10.1016/j.ijdrr.2013.08.004.
14. I. L. Nugraheni, A. Suyatna, A. Setiawan, and Abdurrahman, "Flood disaster mitigation modeling through participation community based on the land conversion and disaster resilience," Heliyon, vol. 8, no. 8, p. e09889, 2022, https://doi.org/10.1016/j.heliyon.2022.e09889.
15. J. N. Edmeade and C. N. Buzinde, "The role of educators in community resilience in natural disaster-prone communities," Community Dev. J., vol. 57, no. 3, pp. 411–429, 2022, doi: https://doi.org/10.1093/cdj/bsab010.
16. I. Triastari, S. I. A. Dwiningrum, and S. H. Rahmia, "Developing Disaster Mitigation Education with Local Wisdom: Exemplified in Indonesia Schools," IOP Conf. Ser. Earth Environ. Sci., vol. 884, no. 1, 2021, https://doi.org/10.1088/1755-1315/884/1/012004.
17. H. Herawati, Kartini, A. A. Akbar, and T. Abdurrahman, "Strategy for realizing regional rural water security on tropical peatland," Water (Switzerland), vol. 13, no. 18, 2021, https://doi.org/10.3390/w13182455.
18. H. Herawati and Kartini, "Mitigasi bencana berbasis kearifan lokal di desa wajok provinsi kalimantan barat," J. Tek. Sipil, vol. 2, no. 1, pp. 1–10, 2019.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.