

Tidal flood and slow onset mobility in the urban community on The Northeast Coast of Central Java, Indonesia

Haryani Saptaningtyas^{1*}, *Singgih Nugroho*², *Damar Waskitojati*², *Agung Waskito Adi*², *Cicilia Dwi Wuryaningsih*², *Ambar Istiyani*³, *Louie Bacomo*⁴, and *Rowena Soreaga*⁵

¹Postgraduate Program. Sebelas Maret University. Surakarta. 57126, Central Java. Indonesia

²Percik Institute, *Kampoeng* Percik, Jl. Patimura Km.1, Salatiga 50711, Central Java, Indonesia

³Sekolah Tinggi Ilmu Ekonomi AMA, Salatiga, Central Java, Indonesia

⁴JRS Asia Pacific, 43 Soi Rachwithi 12, Victory Monument, Phayathai, Bangkok 10400, Thailand

⁵Institute of Environmental Science for Social Change (ESSC). 1/F. Manila Observatory Building Ateneo de Manila University. Quezon City. 1108, Philippines.

Abstract. This paper analyzed the various mobility patterns related to climate change in urban areas, focusing on the impacts of tidal floods and land subsidence in the coastal area of Central Java. The gradual changes in the coastal area are driven by climate change and development plans around the village, which have increased vulnerability. The community often experiences the impacts of rising sea levels and land surface subsidence, damaging the residential environment, public facilities, and hindering transportation and economic activities. This paper explores the experiences of different mobility types, including displacement, voluntary mobility, and immobility. A mixed-method approach was used, involving household surveys, key informant interviews, and community mapping, emphasizing a participatory approach to leverage research for advocacy. The findings suggest that mobility was driven by both the urbanization process and climate change, which have significantly impacted the community. There are various factors influencing their decision to stay or leave the land. Community resilience is one of the drivers of immobility, while the adaptive capacity for livelihood transformation becomes a key factor in their struggle to adapt to climate change impacts.

Keywords: tidal floods, climate change, urban setting, (im)mobility

1 Introduction

In recent decades, global warming and climate change have emerged as major concerns worldwide. This issue is consistently prioritized on the agendas of countries and humanitarian organizations committed to environmental sustainability. Climate change is a phenomenon intricately linked to shifts in economic, social, political, and demographic environments,

* Corresponding author: h.saptaningtyas@staff.uns.ac.id

significantly impacting various aspects of human life, including food crises, ecological disasters, and health impacts. On this paper, we concern on the flooding, which is easier to be understood rather than drought [1] to indicate the ecological disaster related to climate change.

One of the most prominent consequences of climate change is its effect on human mobility, particularly migration and displacement. In its Fifth Assessment Report published in 2014, the Intergovernmental Panel on Climate Change acknowledged mounting evidence that extreme weather events associated with climate change are driving forced migration and displacement, with their impact on human livelihoods further serving as indirect drivers of this shift [2]. Millions of people worldwide have experienced becoming climate refugees. Some have chosen to survive by changing livelihoods, reconstructing settlements, or moving to other places in search of a better life. However, this migration phenomenon is often overlooked in strategies to address climate change. Data from the United Nations High Commission for Refugees as of April 2021 shows that the number of climate refugees has increased to 21.5 million people [3].

According to the World Bank report "Groundswell Part II," without substantial action to mitigate climate change, as many as 216 million people could migrate across six global regions by 2050. These regions include Sub-Saharan Africa, East Asia and the Pacific, South Asia (with 40 million migrants), North Africa (19 million), Latin America (17 million), and Eastern Europe and Central Asia (5 million) [4]. The report further indicates that migration hotspots could emerge as early as 2030 and continue to spread and intensify by 2050. The risks of life-threatening extreme weather events, deteriorating economic conditions and livelihoods, and the loss of habitability in highly exposed areas are driving this population mobility [5].

The term "climate refugees" refers to those who move from their areas of origin due to disasters and natural phenomena related to climate change. Those who migrate because of regional vulnerability to the climate crisis are called "climate migrants." Displacement or disaster displacement in the future is triggered by factors such as disaster exposure, community vulnerability, and hazards stemming from climate change [3]. According to data from the Internal Displacement Monitoring Center, around 87.27 percent of population movements between 2008 and 2018 were related to weather or climate [6].

While not every weather-related disaster can be directly attributed to climate change, the scientific evidence shows that climate change is increasing the frequency and intensity of certain hazards, in this case is tidal floods and strong wave[7]. Furthermore, climate change is exacerbating the vulnerability of communities, making it an increasingly urgent priority to address the underlying drivers of displacement [8]. The groups most vulnerable to climate change-induced migration are the lower middle class, whose livelihoods depend on natural resources and who live in areas exposed to the dangers of climate change. The World Bank predicts the number of climate change migrants based on factors such as vulnerability to water scarcity, low crop productivity, rising sea levels, and high storm intensity. Human mobility in the context of climate change can take various forms, including internal displacement, cross-border migration, and planned relocation, with each presenting its own unique challenges and policy considerations [7],[9].

The UN Resolution 73/195 has encouraged countries to map, develop adaptation strategies, and address climate refugees using a human rights approach. This recognizes climate change and its associated disasters as drivers of migration that need to be addressed. The UN Human Rights Council has also responded by issuing a document on climate change-induced migration from a human rights perspective. This includes efforts to prevent large-scale population displacements by providing a living environment that protects human rights [8]. While a total of 164 countries have signed the 2018 Migration Agreement, which

includes measures to reduce population movements due to climate change, its full implementation remains uncertain.

In Indonesia, this phenomenon of climate migration is already occurring. However, studies on climate change migration are limited. Among these limited studies, the LIPI Population Research Center has investigated environmental migration in the Mahakam Delta, East Kalimantan, in 2015-2016, as well as in North Lombok and East Lombok [9], [10]. Laksmi Rachmawati and Ade Latifa's study in the Mahakam Delta utilized the livelihood trajectories approach. In the case of the Mahakam Delta, migration serves as an adaptation strategy triggered by the loss of mangrove land and increasing tidal waves. The decision to migrate is not an instant process but rather part of a trajectory to maintain their livelihoods [10]. The ability of each household to adapt varies greatly depending on their capabilities and resources, making the adaptations more specific to individual households rather than communal.

Schewel [12] proves the limited research on mobility, without suitable understanding of the causes and consequences of immobility hinders attempts to explain why, when, and how people migrate, even for "migrant populations," and the periods of immobility. Those raises are essential for further research. One of them is understanding the complex reasons and interplay dimensions for someone to move or not to move.

Black et al. [13] and Martin et al. [14] note that some communities do not see migration as a feasible climate coping strategy as it is perceived as costly, involves high uncertainty, and may lead to more challenging situations. Displacement tends to be perceived as a "failure to adapt" and can be understood as a form of loss and damage associated with climate change [15], while planned relocation and resettlement are increasingly recognized as climate adaptation measures that also contribute to climate resiliency among communities [16]. Thus, in the human mobility spectrum, the phenomenon of "immobility" that often leads to "trapped populations": those who are unable to move out of a direct danger or crisis due to physical, financial, security, logistical, health and/or other reasons despite facing direct exposure and existential threat from climate-related threats such as sea-level rise.

Intergovernmental Panel on Climate Change the Sixth Assessment Report or IPCC AR6 [5], the risk of displacement increases when communities in rural and urban areas that lack the resources to migrate experience higher exposure to extreme weather events, particularly in low-income developing countries. Thus, this paper highlights the motif, the strategies, and time of the slow on-set mobility of the urban community who is threatened by tidal flood and abrasion [17].

Based on the book *"Maleh Dadi Segoro"* written by the Semarang Demak Coastal Coalition team, it provides information related to various factors causing this ecological crisis, namely that groundwater extraction originates from human needs for water both on a household scale and (later) on an industrial scale. That happened since the 1900s. It is recorded that the total groundwater withdrawal in the city of Semarang is measured at an average of 60 million cubic /year or 1.9 cubic / second [18].

This paper examines the impacts of climate change and the adaptation strategies employed by communities in the northern coastal region of Central Java. Drawing on a case study of Tambakrejo Village, RW 16, Tanjung Mas Subdistrict, North Semarang District, Semarang City, the article explores how these coastal communities are directly experiencing the effects of climate change through tidal flooding and seawater intrusion. The natural phenomena occurring in this area, including the Tanjung Mas Harbor region, are part of the broader trend of rising sea levels driven by global warming. Tidal floods have been occurring in the region since the early 1990s, a result of regional development that failed to account for the impact on the natural environment.

2 Method

A mixed method was used, involving household surveys, key informant interviews, and community mapping, emphasizing a participatory approach to leverage research for advocacy. Purposive sampling was used to determine the respondents in the location, which was chosen purposively based on the assessment stage. The advantage of purposive samples is that they can generalize survey findings at the population level. The minimum research sample size to ensure saturation through the full spectrum of gender, generation, and socioeconomic status. The sample of this household survey was 200 people. The main objectives of this survey are to obtain more detailed data regarding the respondent's household profile (name, gender, age, occupation, education, organization, religion, marital status, etc.) and to explore asset and place attachment. This research also applies key informant interviews to explore the experiences and adaptation strategies of families living in coastal areas and remote islands facing climate change and extreme weather. Community mapping was done participative involving community members to draw the cognitive map of people. Community mapping focuses on the social and land-used practices of the people in the coastal area to encourage young and old people, men and women, to speak and to draw the map, for they all have different experiences with the land and have different roles to play [19].

3. Results and Discussions

2.1 Overview of the Study Area

Tambakrejo Village is a coastal community with both urban and rural characteristics. This village is home to 1,719 residents and 535 households, with a breakdown of 847 male and 872 female inhabitants. Administratively, Tambakrejo RW 16 is located within Tanjung Mas Village, in the North Semarang District of Semarang City. The village is situated in close proximity to Semarang's economic and transportation hubs, such as the Kota Lama area, the train station, and Tanjung Emas Harbor. Geographically, Tambakrejo is surrounded by water bodies. The northern boundary is the Java Sea, the eastern side is bordered by the East Flood Canal and Banger River, while the Mati River defines the western boundary.

In the past, Tambakrejo was known for its fishing industry due to its coastal location. However, since the 2000s, residents' fish ponds have begun to disappear, submerged by seawater. Nowadays, the village's occupational profile has diversified, with some residents employed in nearby industries like PT Pelindo and PT Indonesia Power, while others continue the fishing tradition. Despite the decline in the fishing profession, residents who are part of fishing groups are advocating for Tambakrejo to be recognized as a Maritime Village.

The community mapping exercise in Tambakrejo has revealed the village's experiences with climate change, as evidenced by the disappearance of land and landmarks that the residents have documented through participatory mapping techniques (see Picture 1).

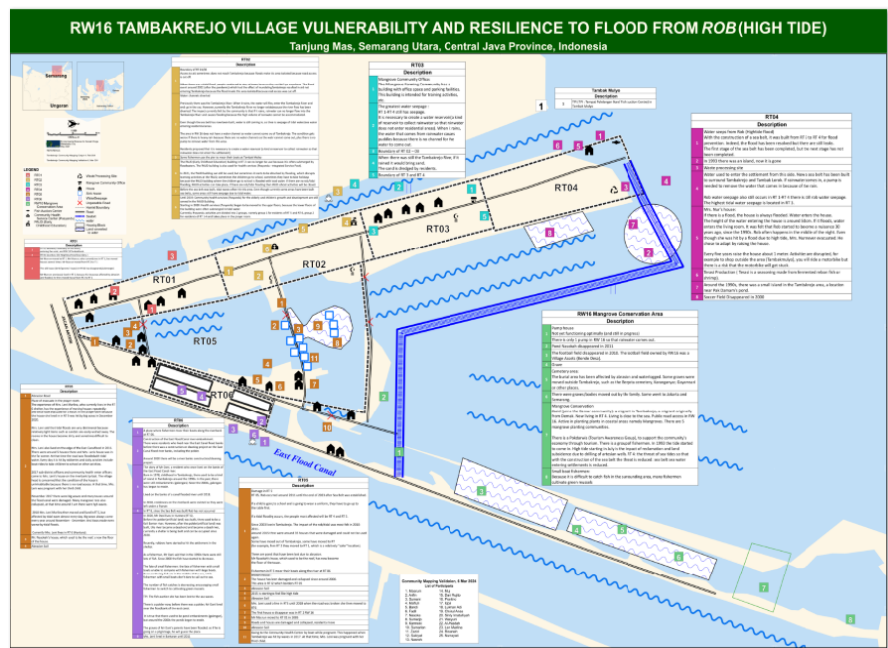


Figure 1. Result of Tambakrejo Integrated Community Mapping, a part of Participatory Research Process

2.2 Vulnerability of Tambakrejo Area

Located near the sea, the Tambakrejo village frequently deeply impacts of rising sea levels and also undergoing land subsidence, which has led to damage to residential environments and public infrastructure like roads, as well as hindering transportation and economic activities within the community. According to survey findings, the five most common disasters experienced by residents include sea waves, increased beach and ocean litter, flooding from high tides, mangrove forest loss, and soil/sand erosion.

The landscape of this area has undergone significant changes compared to the pre-2000s period. Residents have reported that tidal waters began encroaching on the settlement around July 1993, and by 2000, flooding and erosion had caused the loss of public facilities such as cemeteries, sports fields, and ponds, while seawater also started inundating people's homes. The most devastating disaster felt by Tambakrejo residents was the combination of high waves and rising sea levels in 2015, which damaged 35 houses and numerous fish ponds beyond repair due to permanent submersion.

This gradual transformation of the landscape is attributable not only to climate change but also to the impacts of development around the village and the behavior of its residents. For instance, the construction of the East Flood Canal embankment in 2020 caused the Banger River to deteriorate. Additionally, improper household waste management by residents has contributed to the degradation of the village environment. The survey revealed various impacts from seawater intrusion, including damage to vehicles and homes, disruption of work and social activities, and a pervasive sense of threat among the residents.

These changes in natural conditions, based on household survey data, have made the majority of Tambakrejo residents feel uncomfortable and threatened by their environment. The remaining residents reported feeling normal, and only 3 percent felt safe. This is

understandable, as some residents consider the hazardous conditions to be a part of their daily lives.

To address these issues, residents have proposed a sea embankment construction program to the government. Over the past few years, the Pemali Juana River Basin Center, under the control of the PUPR Ministry, has carried out the development of this sea embankment project. While the community believes the sea embankment can reduce the impact of tidal flooding, it cannot eliminate it completely, as seawater seepage still occurs along the old sea embankment. The sea wall construction project also includes Tambak Mulyo Village, another area in Tanjung Mas Subdistrict facing similar environmental challenges as Tambakrejo. For residents, the sea embankment, accompanied by mangroves—an example of so-called gray-green architecture—has been crucial in mitigating the impacts of tidal flooding.

2.3 Economic Vulnerability

The loss of ponds in Tambakrejo has also impacted the local economy. Residents must adapt to environmental changes, including shifting their livelihood strategies. Survey results indicate that most residents derive income from private employment. Other income sources include fishing, government assistance, and family support. Additional income comes from small-scale businesses like freshwater fish farming, services, and home stalls. Fishermen who depend their livelihood on the sea, face numerous challenges, including erratic seasons that make it difficult to go to sea, and decreased production of green mussels. Furthermore, the availability of nearshore fish has declined due to various developments in the Tambakrejo area.

Based on survey data, the majority of residents' weekly expenditures are for food, including kitchen needs, purchasing sea fish, and buying eggs and milk. Some residents also spend on drinking water and fast food. For non-food expenses, the majority is spent on home needs, education costs, and boat maintenance. Communication and savings costs are lower, as are health-related expenses.

Limited income, coupled with demands for meeting life's necessities, leaves Tambakrejo residents in a vulnerable economic position. The majority of non-food expenses go towards home needs, education costs, and boat maintenance. Meanwhile, communication, savings, and health-related costs are lower. The data shows that the majority of residents have economic vulnerabilities in their households due to limited income and increasingly varied spending demands. Residents' decisions not to move have significant consequences for their housing needs. Some residents independently have to pay ± IDR 20 – 30 million to raise the floor of their house by 1 meter every 5 years. Residents finance these home repairs through various sources, such as their own businesses, help from family or relatives, debts to official or unofficial lending institutions, government assistance, and support from civil society institutions.

2.4 Water, Sanitation and Hygiene

The environmental changes have also impacted the availability of clean water, sanitation, and cleanliness. According to health authorities, the quality of water from surface wells is no longer recommended. Residents meet their clean water needs in two ways - for bathing and for drinking. Thirty percent of residents use private artesian wells and water from the municipal water supply. For drinking water, many residents purchase refillable or mineral water, though some still obtain it from unpumped wells. When it comes to sanitation, residents use either private or public toilet facilities.

In the Tambakrejo area, there are no government or private health facilities. The health of residents, particularly the elderly, mothers, and children, is only monitored through the Posyandu program, which rotates across each neighborhood unit. The community previously had a Posyandu building, constructed with private sector assistance, but it can no longer be used as it has been submerged by floodwaters.

Waste management remains a significant challenge in this village. The lack of proper waste disposal facilities has led to the proliferation of litter in various corners of the village, including between houses, near water bodies, and in a designated communal dumping area in RT 05. The waste originates from household consumption and is also brought in from outside the village via the nearby river. Residents have developed different approaches to managing waste, such as sorting, discarding it in communal areas, and even using it as material to raise the floors of their homes.

2.5 (Im)mobility

Despite being aware that living in an area prone to disasters and environmental hazards is unhealthy, the majority of Tambakrejo residents are reluctant to move to safer and more comfortable locations. Reasons cited include strong attachment to their families and livelihoods, as well as general contentment with their current situation. Other factors, such as the cost of moving and not having another place to go, also contribute to this reluctance.

This reluctance is further reinforced by the survey findings, which indicate that 76% of respondents are property owners in Tambakrejo. Additionally, most respondents have lived in the area for more than 10 years, with some having resided there for multiple generations. This deep-rooted connection to the place they call home makes the residents hesitant to leave.

The reluctance to move is also strengthened by several factors, including the status of home asset ownership. This can be seen in the respondents' housing situation - the majority own their own property or family-owned property, while others rent either with or without payment. Additionally, the majority of respondents have lived in the study location for more than 10 years, with some having resided there for multiple generations. The deep-rooted connection to their home and community, as well as their livelihoods, are cited as key reasons for their reluctance to relocate.

When respondents were asked whether they would consider moving, the majority said they would not. Several reasons emerged, including strong attachment to their families and livelihoods, as well as general contentment with their current situation. Other factors, such as the high cost of moving and a lack of alternative places to relocate, also contributed to their reluctance. This reluctance is evident in the survey results, which show that only 8 percent of family members have moved to another location in the last 10 years.

The residents' decision not to move, while understandable, has had significant economic consequences. Some residents have had to independently pay substantial sums to repair their homes, such as raising floors, foundations, walls, and roofs. These home repairs are financed through various sources, including their own businesses, help from family or relatives, debts to lending institutions, government assistance, and support from civil society organizations. Additionally, there have been communal efforts to address the challenges, such as constructing drainage systems, boundary walls, and providing water pumps.

Despite the majority of Tambakrejo residents remaining in their homes, the survey data revealed instances of movement among some residents. There are two types of displacement identified: forced and voluntary. The primary factors motivating residents to relocate include eviction, damage to their homes due to disasters, securing better employment opportunities, and marrying someone from outside the village. Additionally, government development

policies, environmental threats and disasters, as well as family considerations have prompted some residents to move.

One such case of independent movement was observed among residents of RT 05. Homes in this neighborhood suffered damage from sea waves, forcing residents to relocate within Tambakrejo or to nearby areas of Semarang City. Currently, RT 05 is occupied by only around 15 families, down from the previous 45 households. Some of the residents who moved have maintained their livelihoods in Tambakrejo.

For residents who were forced to relocate, their attachment to the sea remained influential. The majority of respondents expressed a desire to move to urban locations near the coast. This was the case for residents of RT 6 in Tambakrejo, who had previously lived along the Banjir Kanal Timur. Their land was destroyed by a river management program, compelling them to move. After a long process involving the Central Java provincial government and civil society activists, these residents were eventually granted temporary housing by the government in 2019.

2.6 Gender and (Im)mobility

Female respondents in Tambakrejo play a significant role in influencing their families' decisions about whether to move or remain in their current homes. When it comes to the reasons for staying in vulnerable areas, female respondents cited various factors, including: a) strong family ties; b) reliance on local livelihoods; c) lack of alternative places to relocate; d) the high cost of moving; and e) contentment with their current situation.

Both women and men in Tambakrejo agree that family ties and livelihood are two crucial factors in deciding not to move. However, the survey indicates that family is a stronger factor for women, with 56% of female respondents agreeing or strongly agreeing that they would likely move if not for their families, compared to 47% of male respondents. Additionally, more women expressed complete agreement that they have fond memories of the place and are comfortable living there, while more men were in full agreement that Tambakrejo is important to them. This perceived importance of the place by men could be related to their primary occupation of fishing, as men tend to be the main breadwinners in their families.

When it comes to the decision to move, the main reason that emerged was eviction. Other factors include loss of livelihood, loss of residence, and marriage. The consideration of eviction as a primary reason for moving shows that there is awareness among the residents regarding land ownership and government authority.

3 Research Implications

The findings from this study have several implications for understanding the complex dynamics of human mobility and immobility in the context of coastal communities facing environmental threats. First, it highlights the deep-rooted attachment and sense of place that residents have towards their homes and communities, even in the face of significant environmental challenges. This attachment, coupled with economic and social factors, contributes to the reluctance of many residents to relocate, despite the risks they face [20][22].

Second, the study underscores the gendered nature of mobility decision-making, with women playing a significant role in shaping the family's decision to stay or leave. This suggests the importance of considering gender dynamics in understanding and addressing climate-induced displacement and migration [23].

Third, the study underscores the importance of considering both forced and voluntary forms of mobility when examining the impacts of climate change on human settlements.

While some residents may be forced to relocate due to disasters or development policies, others may choose to move in search of better economic opportunities or personal reasons [24]. Fourth, the study highlights the need for more holistic and integrated policies and interventions that address the multidimensional aspects of climate-induced mobility, including social, economic, and environmental factors [20].

4 Conclusion

The change in natural conditions, based on household survey data, has made the majority of Tambakrejo residents feel uncomfortable with their environment (60 percent) and feel threatened (9 percent). Climate changes heavily impact tidal flooding worsened by a lack of good drainage management, which impacts poor water and sanitation.

The situation indirectly induced people to migrate to other locations or resist adapting, living with flooding. Even though we found that some older generations prefer to stay in vulnerable areas, the younger generation is primarily mobilized to urban sites. Living conditions related to health, jobs, and education are the main priorities of women when deciding between mobile or immobile.

This urbanized area experienced high exposure to climate change impacts, high socioeconomic vulnerability. This gradual change in the landscape is caused by climate change, and the impact of development around the village, such as the construction of the East Flood Canal river embankment (river normalization) in 2020, has fostered the liveable condition of the urban community.

Acknowledgement : This research is part of the Research and Advocacy for Climate Policy and Action-RACPA program. RACPA is a program designed by JRS AP, Percik, ESSC, with the support of Caritas Australia and Australia AID, with a focus on the adaptive response of communities facing high risks of internal displacement due to climate change and disasters, as well as the policy environment that influences policies that have an impact on their response. This project aims to help develop a deeper understanding and knowledge of climate change, vulnerability and displacement among different stakeholders, and contribute to strengthening the resilience of coastal and island communities, through the development of more inclusive and collaborative policies to address the complexities of population displacement.

References

- [1] Choukri, M., Naimi, M., Chikhaoui, M. (2023). Drought characterization: A systematic literature review. *Sains Tanah Journal of Soil Science and Agroclimatology*, 20(2): 250-264. <https://doi.org/10.20961/stjssa.v20i2.77206>
- [2] C. Sabine, "The IPCC Fifth Assessment Report," *Carbon Management*, vol. 5, no. 1. 2014, doi: 10.4155/cmt.13.80.
- [3] G. S. Goodwin-Gill and J. McAdam, "UNHCR and climate change, disasters, and displacement," *UNHCR - UN Refug. Agency*, 2017.
- [4] V. Clement *et al.*, "Groundswell: Acting on internal climate migration," *World Bank Gr.*, 2021.
- [5] K. Boudreau, M. Robinson, and Z. Farooqi, "The IPCC Sixth Assessment Report," *Canadian Journal of Emergency Management*, vol. 2, no. 1. 2022, doi: 10.25071/6sw6za31.
- [6] International Displacement Monitoring Centre, "Disaster Displacement: A global review 2008-2018, Thematic Report." pp. 1–56, 2019, [Online]. Available: <https://www.internal-displacement.org/sites/default/files/publications/documents/201905-disaster->

- displacement-global-review-2008-2018.pdf.
- [7] M. E. Kabir, S. Serrao-Neumann, P. Davey, M. Hossain, and M. T. Alam, "Drivers and temporality of internal migration in the context of slow-onset natural hazards: Insights from north-west rural Bangladesh," *Int. J. Disaster Risk Reduct.*, vol. 31, 2018, doi: 10.1016/j.ijdr.2018.06.010.
 - [8] D. Manou, A. Baldwin, D. Cubie, A. Mihr, and T. Thorp, *Climate change, migration and human rights: Law and policy perspectives*. 2017.
 - [9] S. Balsari, C. Dresser, and J. Leaning, "Climate Change, Migration, and Civil Strife," *Current Environmental Health Reports*, vol. 7, no. 4. 2020, doi: 10.1007/s40572-020-00291-4.
 - [10] L. Rachmawati and A. Latifa, "Lintasan Penghidupan (Livelihood Trajectories) dan Migrasi Lingkungan di Delta maakam," *J. Kependud. Indones.*, vol. 15, no. 1, 2020, doi: 10.14203/jki.v15i1.475.
 - [11] A. Latifa and H. Romdiati, "Kebijakan Pengelolaan Migrasi dalam Konteks Perubahan Iklim: Kasus Lombok Utara dan Lombok Timur," *J. Kependud. Indones.*, vol. 12, no. Desember, 2017.
 - [12] K. Schewel, "Understanding Immobility: Moving Beyond the Mobility Bias in Migration Studies," *Int. Migr. Rev.*, vol. 54, no. 2, 2020, doi: 10.1177/0197918319831952.
 - [13] R. Black, W. N. Adger, N. W. Arnell, S. Dercon, A. Geddes, and D. Thomas, "The effect of environmental change on human migration," *Glob. Environ. Chang.*, vol. 21, no. SUPPL. 1, 2011, doi: 10.1016/j.gloenvcha.2011.10.001.
 - [14] M. Martin, M. Billah, T. Siddiqui, C. Abrar, R. Black, and D. Kniveton, "Climate-related migration in rural Bangladesh: A behavioural model," *Popul. Environ.*, vol. 36, no. 1, 2014, doi: 10.1007/s11111-014-0207-2.
 - [15] Advisory Group on Climate Change and Human Mobility, "COP27 Must Act on Human Mobility." 2021, [Online]. Available: <https://disasterdisplacement.org/resource/cop27-must-act-on-human-mobility/>.
 - [16] UNHCR, "Guidance on protecting people from disasters and environmental change through planned relocation," no. October. pp. 1–22, 2015, [Online]. Available: <https://www.refworld.org/policy/opguidance/unhcr/2015/en/117656>.
 - [17] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022 – Impacts, Adaptation and Vulnerability*. 2023.
 - [18] B. Batubara, H. Warsilah, I. Wagner, and S. Salam, *Maleh dadi Segoro; Krisis Sosial-Ekologis Kawasan Pesisir Semarang-Demak*, no. October. Yogyakarta: Lintas Nalar, 2020.
 - [19] Environmental Science for Social Change, "Community-Mapping-Manual.pdf." 1998, [Online]. Available: <https://essc.org.ph/content/archives/73>.
 - [20] B. Mallick, C. Priovashini, and J. Schanze, "'I can migrate, but why should I?'—voluntary non-migration despite creeping environmental risks," *Humanit. Soc. Sci. Commun.*, vol. 10, no. 1, 2023, doi: 10.1057/s41599-023-01516-1.
 - [21] Z. Shu, Y. Du, and X. Li, "Homeland, emotions, and identity: Constructing the place attachment of young overseas Chinese relatives in the returned Vietnam-Chinese community," *Front. Psychol.*, vol. 14, 2023, doi: 10.3389/fpsyg.2023.984756.
 - [22] W. P. Tyas, "Living in Prone Flooding Area: In Coastal Areas of Semarang," in *IOP Conference Series: Earth and Environmental Science*, 2018, vol. 123, no. 1, doi: 10.1088/1755-1315/123/1/012010.
 - [23] B. Tripathy Furlong, H. Adams, I. Boas, J. Warner, and H. Van Dijk, "Gendered (im)mobility: emotional decisions of staying in the context of climate risks in Bangladesh," *Reg. Environ. Chang.*, vol. 22, no. 4, 2022, doi: 10.1007/s10113-022-

- 01974-4.
- [24] M. M. Naser, B. Mallick, R. Priodarshini, S. Huq, and A. Bailey, “Policy challenges and responses to environmental non-migration,” *npj Clim. Action*, vol. 2, no. 1, 2023, doi: 10.1038/s44168-023-00033-w.