



Mosque in the remains of a flooded village near Bekasi. © Adriana SIERRA LEAL and Meylin GONZALES HUAMAN 2017

# Migration, environment and climate change in coastal cities in Indonesia

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## Introduction

Indonesia is an archipelagic nation in South-East Asia and situated in one of the world's most vulnerable regions to climate change. Indonesia's exposure to a variety of hydrometeorological hazards – including sea-level rise, coastal erosion and land subsidence – combined with a high population density and concentration of economic

activities in low elevation coastal zones (LECZs), make it particularly vulnerable to climate change. Already, environmental phenomena are impacting coastal livelihoods, displacing villages and driving individuals and communities to migrate.

This policy brief aims to contribute to the existing knowledge base on the interconnections between migration, environment and climate change in urban coastal areas in order to inform further research and identify programmatic and policy priorities. It is based on an extensive desk review and interviews with affected community members, government agencies, civil society and international organizations in Java, Indonesia.<sup>1</sup> This brief presents an overview of the environmental phenomena affecting urban coastal areas in Java, the resulting livelihood impacts and the emerging migration patterns and main enablers and constraints of environmental migration, as well as recommendations on the way forward.

## Internal migration patterns

The majority of data on migration in Indonesia focuses on international migration. While international migration flows to and from Indonesia have increased in the past decades due to a variety of mainly economic factors, environmental migration tends to take place internally and presents a challenge for data collection. The limited data available on environmental migration flows in Indonesia indicates that internal migrants constitute a significant percentage of the population. In 2010 alone, 9.8 million individuals were estimated to be internal migrants. Java is both an in-migration and outmigration hotspot: from 2005 to 2010, over 550,000 internal migrants arrived, and nearly 1 million individuals left the island in the same period (United Nations Population Fund (UNFPA), 2015:20). Indonesia is also experiencing high rates of rural-to-urban migration, with most migrants moving in search for employment opportunities (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2018:3). Women comprise 47.6 per cent of the internal migrant population (*ibid.*, 4). National census data for the period from 1995 to 2010 further suggests that a higher proportion of interprovincial migrants are young, unmarried and more educated (UNFPA, 2015:75).

This data also identifies three main factors associated with internal migration: (a) employment opportunities or lack thereof; (b) improved transportation and information networking; and (c) an ever-growing informal sector (UNFPA, 2015:19). This confirms findings from earlier studies that have found economic factors to be strongly associated with internal migration.

Recently, internal migration has been linked to climate change, particularly in the greater Jakarta area. With increasingly adverse impacts of coastal flooding and permanent land loss, internal migration is expected to take place from high-risk urban areas to lower risk urban areas (UNESCO, 2018). Environmental migrants tend to be from low-income households and irregularly migrate to peri-urban areas that receive little to no State services (UNICEF, 2011). Despite these findings, more research and evidence on environmental migration in Indonesia is needed to clearly understand the emerging migration patterns and the challenges and opportunities that they present.

## Environment and climate change in urban coastal areas

Indonesia's geographic characteristics renders the country highly exposed to climate impacts. Furthermore, Indonesia is experiencing rapid rates of urbanization, including in LECZs: over 50 per cent of the country's 260 million inhabitants live in urban areas and are concentrated in the island of Java, with the most populated coastal cities being Jakarta, Semarang and Surabaya (World Bank, n.d.). With the largest proportion of its population concentrated in coastal zones, the World Bank has ranked Indonesia as the 12th out of 35 countries with high mortality vulnerability to climate-related hazards (Lassa et. al., 2014).

Indonesia's main economic activities in urban LECZs are also vulnerable to climate change as they are based on the availability of natural resources, including fish, shellfish and salt, as well as infrastructure located in high-risk areas. Natural resource-based economies and livelihoods are disproportionately vulnerable to climate impacts and environmental changes that may reduce the availability of resources.

This policy brief mainly focuses on three interrelated hydrometeorological phenomena that are impacting coastal livelihoods, particularly those that are situated in LECZs and that are natural resource dependent. These phenomena include **sea-level rise, land subsidence and coastal erosion**, and cause damages as a result of flooding or *rob*<sup>2</sup> and permanent land loss.

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<sup>2</sup> *Rob* is a Bahasa term that refers to any time water from any body of water floods human-made infrastructure and disrupts daily life. It is often used interchangeably with flooding and coastal flooding. *Rob* is used throughout this article as it reflects flooding (submerged and dry) and water that covers usually dry land but does not necessarily submerge it.





Houses affected by land subsidence on the outskirts of Semarang. © Adriana SIERRA LEAL and Meylin GONZALES HUAMAN 2017

Sea-level rise is of grave concern to LECZs. The Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report of 2014 estimates that by the end of the twenty-first century, "[a]bout 70 per cent of the coastlines worldwide are projected to experience a sea level change within  $\pm 20$  per cent of the global mean" (2014:13). If the 1.5°C target is met, sea-level rise is projected to be 0.1 m lower than with a global warming of 2°C (IPCC, 2018). In this sense, even if global mean temperature is stabilized, LECZs would still be at risk from sea-level rise (IPCC, 2014:13).

In 2008, more than 72,000 people were already living in areas situated below mean sea level in Semarang, and 40 per cent of the surface of Jakarta is located below sea level (JustJobs Network, 2015:20). Currently, the sea level surrounding Jakarta rises 0.57 cm every year. If no adaptation and mitigation actions are taken, large areas of the densely populated Jakarta could be submerged by 2045 (ibid.).

Indonesian coastal urban areas are also experiencing land subsidence, which is the downward movement or sinking of land surface. Land subsidence results primarily from unregulated and excessive groundwater extraction and infrastructure development on reclaimed land. Rapid urbanization rates are driving the increasing rate of groundwater extraction, and consequently the land subsidence rates.

Both sea-level rise and land subsidence are accelerating rates of coastal erosion – the wearing away of the coast. The combination of these environmental changes with naturally occurring phenomena, such as the annual monsoon season, make *rob* more frequent, unpredictable and intense, resulting in deteriorating infrastructure, loss of livelihoods and disrupted daily activities.

### Impacts of environmental changes on livelihoods

LECZs in Indonesia are already experiencing the impacts of sea-level rise, land subsidence and coastal erosion (see Harwitasari and van Ast, 2011). *Rob* reduces sources of income, deteriorates infrastructure, disrupts daily activities and adversely impacts health and nutrition. Ultimately, the impacts of *rob* can influence people's decision to migrate.

The following insights into the impacts of *rob* and environmental changes are based on semi-structured interviews and focus groups with individuals living and working in communities affected by hydrometeorological impacts and with representatives from the government and organizations working on the thematic areas of disaster risk reduction (DRR), migration and climate change in Bekasi, Demak, Jepara and Semarang, as shown in Table 1.

Table 1: Research sites and interviewees

City/Organization		Characteristics	Type of interview
Bekasi	Desa Pantai village	A low-income village where the majority of the population derives its income from fishing.	Interviews with three household heads and one focus group.
	Al Jazeera	Interview with Al Jazeera producer and journalist given her knowledge of the lived realities of individuals in Bekasi.	
Demak	Bedono village	A village in the industrial area of Java that is affected by flooding and sea-level rise. The majority of the population derives its livelihood from fishing-related activities and agriculture.	Interviews with five women and men and one focus group.
	Puspita Bahari	Cooperative of fisherfolks who work to empower women fisherfolks and women in fishing communities.	Interview with the head of Puspita Bahari and a focus group with six female fisherfolk members.
Jepara	Bulakbaru village	A village that was partially relocated in the late 1980s as a result of permanent land loss due to coastal erosion and flooding. The main economic activities of what remains of the village include fishing and salt farming.	One focus group.
	Semat village	A village largely comprised of the individuals who were displaced from Bulakbaru. Main sources of income include agricultural activities, fishing and furniture making.	One focus group.
	Badan Penanggulangan Bencana Daerah (BPBD) Jepara	Indonesian Regional Agency for Disaster Management in Jepara.	Interview with representatives based in Jepara.
Semarang	Panggung Lor neighbourhood	A neighbourhood on the coast bordered by two rivers. Drainage and pump system were installed through community-level initiatives to address severe floods.	Interviews with three women and men and one focus group.
	Mercy Corps	Mercy Corps is a global team of humanitarians who partner with communities, corporations and governments to transform lives around the world. In Indonesia, Mercy Corps works on disaster preparedness and emergency response, as well as in improving economic opportunities, sanitation and maternal health.	Focus group with representatives from the Zurich Flood Resilience Project who provided insights on resilience assessment strategies and DRR policymaking challenges.
	BPBD Semarang	BPBD coordinates national and local response to disasters and emergency situations.	Interview with representatives based in Semarang.
	Badan Perencanaan Pembangunan Daerah (BAPPEDA) (Regional Agency for Development Planning)	In Semarang, the development agency focuses on climate change and collaborative projects with Mercy Corps to build community resilience.	Interview with two representatives based in Semarang.
	Badan Meteorologi, Klimatologi, dan Geofisika (BMKG) (Indonesian Agency for Meteorology, Climatology and Geophysics)	Interviews carried out with the following: (a) representatives from the Geospatial and Climate Unit focusing on data collection and information dissemination on rainfall patterns, rain forecasts and season change; (b) representatives of the Maritime Unit, which runs a project in Jakarta and Semarang to forecast coastal inundation; and (c) a national-level BMKG representative, who is involved in assisting fisherfolks, oil and fishing companies with memorandums of understanding, capacity-building activities and providing information on oceanography.	





Houses affected by land subsidence in Demak. The ground floor of the house on the left has been elevated as a response to subsidence and *rob*. © Adriana SIERRA LEAL and Meylin GONZALES HUAMAN 2017

## Impacts on income

Low-income urban coastal areas in Indonesia are highly dependent on natural resources, and most households in the research locations derive their income from fishing, fishponds or agricultural activity. Fisherfolks and women reported declining fish stocks, which led to reduced and fluctuating income. Declining fish stocks can be partially explained by rising ocean surface temperatures, ocean acidification and pollution and unsustainable fishing practices. Fishpond farmers also noted that *rob*, coastal erosion and storms deteriorate fishpond infrastructure, causing declines in productivity and resulting in high maintenance costs. Despite these challenges, many farmers have converted rice paddies to fishponds as the cost of maintenance is lower.

Those who continue to derive their income from agriculture in the form of rice paddies are faced with soil salinization and declining yields due to continued *rob*. In addition, unpredictable rainfall patterns and drought are also having a negative impact on crops and agricultural incomes. While the agricultural sector continues to employ over 34 per cent of the Indonesian population, over 900,000 jobs in agriculture were lost from 1995 to 2015. Many of the urban jobs that have been created as a result are in the informal sector (UNESCO, 2018:2).

## Impacts on infrastructure

As noted above, *rob* causes significant damage to income-generating infrastructure like fishponds and agricultural fields. The high frequency of *rob* also deteriorates both private and public infrastructure, including roads, houses, mosques, factories, medical facilities and schools. Existing infrastructure requires constant renovations that are costly for households, business enterprises and government bodies. In extreme cases, entire villages have been destroyed by *rob*, and coastal erosion has resulted in permanent land loss.

## Impacts on education and daily activities

The increasing frequency and unpredictability of *rob* disrupts daily activities, including school hours, commuting and business operations. The extent to which *rob* disrupts these activities depends on its length and intensity, as well as on existing infrastructure. Schools may have to modify their schedules or cancel classes entirely, while children may be unable to attend school due to *rob*. In some instances, lessons may take place in unsafe environments.

In addition to disrupting daily school lessons, *rob* often makes it difficult for individuals in affected areas to commute to work, as roads and homes may be flooded. Scooters and motorcycles have to be regularly maintained or replaced, preventing individuals from commuting and adding an additional cost to the household. Similarly, local business owners may have to adjust their business hours or close shops in the incidence of *rob*.

### Impacts on health and nutrition

*Rob* has reportedly affected water sources, as it can increase salinity and decrease the quality of groundwater and existing water storage facilities. In these cases, *rob* can result in water that is unsafe for drinking, cooking and sanitary purposes. Several interviewees mentioned that they experienced rashes when showering after *rob* and that they never felt clean. In addition to salinization of water sources, *rob* also sweeps up waste and pollution inland, making diarrhoea and skin issues a common

occurrence. Several interviewees also reported a higher number of mosquitoes and the threat of waterborne diseases. When lasting for several days, *rob* also threatens food security by impeding the transportation of food to coastal areas and causing crop, livestock and fish stock losses.

### Gender dimensions

The impacts of climate change are gendered, and therefore it is crucial for adaptation strategies and further research to integrate women's situated knowledge, unique vulnerabilities and adaptive capacities and strategies. Women fulfilling more traditional roles such as household and care work reported distinct concerns over health, education and nutrition that men often failed to address. In addition, while both men and women experienced similar barriers to migration, these barriers were often disproportionately greater for women due to mobility and financial constraints, limited transferable skills and ties to household responsibilities.

Figure 1. Impact of *rob* on livelihoods



Source: Leal and Gonzales Huaman, 2019.

Note: This figure is produced by the authors.

## Adaptation strategies to environmental changes

National policy and frameworks on climate change in the country do not consider the linkages between climate change and migration. As a result, environmental migrants are absent from national programme and policy strategies. Considering this gap, individuals, communities, government agencies and development actors in affected coastal areas are implementing adaptation strategies to reduce the livelihood impacts caused by slow-onset environmental phenomena and climate change. This section describes the adaptation strategies reported in semi-structured interviews with representatives from BAPPEDA, BMKG, BPBD and Mercy Corps, as well as from focus groups with affected individuals in urban coastal villages (see Table 1 for details).

### Climate adaptation frameworks

In 2014, the Government of Indonesia launched the National Action Plan on Climate Change Adaptation (RAN-API) in an effort to mainstream climate change adaptation into national development planning. Led by the Adaptation Working Group, RAN-API coordinates adaptation activities with key stakeholders, namely government, community-led organizations and private sector actors (Sekretariat RAN-API, n.d.). RAN-API is complemented by legislature, such as law no. 32 (2009) and law no. 33 (2016), which shape policies on natural resource management and urban planning as mechanisms to increase adaptive capacity and resilience to climate change.

Table 2: Current adaptation strategies

City/Organization	Strategy description	Challenges
<b>Climate and disaster resilient infrastructure</b>		
<b>Elevating built infrastructure</b>	Affected households raise ground floors and build additional floors to decrease the impact of <i>rob</i> and compensate for land subsidence. Public infrastructure has also been modified with financing from the Government. Most notably, roads have been elevated.	<b>Added socioeconomic costs</b> Elevating built infrastructure requires significant financial resources. Furthermore, when public roads are elevated, they may exacerbate flooding in surrounding areas where private homes have not been elevated.
<b>Protecting valuables</b>	Affected households construct water-resistant platforms to keep valuables dry and/or afloat. Stacks of sandbags are also placed at the entrance of the houses to decrease the impact of <i>rob</i> .	<b>Temporary measure</b> While reducing the losses caused by <i>rob</i> , these strategies only constitute temporary measures. They are reactionary coping strategies to sea-level rise, land subsidence and coastal erosion.
<b>Building and/or growing barriers and wave breaks</b>	At the village level, several initiatives emerged to create wave breaks and barriers against <i>rob</i> and tidal waves. Initiatives include the construction of <i>tangguls</i> (mud barriers) and mangrove reforestation as natural barriers. At the national level, large-scale wave breaks are being built to protect valuable infrastructure and ports.	<b>High maintenance cost and limited effectiveness</b> <i>Tangguls</i> , wave breaks and mangroves need maintenance and constant adaptation to rising sea levels and increasing land subsidence. Wave breaks are a temporary adaptation strategy. While they may provide a temporary protection from tidal waves and reduce the pace of coastal erosion, their effectiveness against sea-level rise is limited.
<b>Drainage and pumping systems</b>	In cooperation with city government and Mercy Corp's Zurich Project, the Panggung Lor district Community of the Mitigation and Control of Panggung Lor Rob (P5L) has developed extensive drainage and pump systems to reduce flooding throughout the neighbourhood.	<b>Civil society, public and private sector cooperation and funding</b> Affected areas would need involvement from civil society and support from both public and private actors for this strategy to be successfully replicated. Furthermore, installing a comprehensive drainage and pumping system can be costly and require resources for upkeep.

City/Organization	Strategy description	Challenges
<b>Socioeconomic capital for adaptation</b>		
<b>DRR training</b>	Indonesia counts with a comprehensive DRR system. In the study areas, Mercy Corps and the Regional Agency for Disaster Management (BPBD) implement DRR trainings that include information on first aid, contingency planning and the provision of walkie-talkies and first-aid kits. BPBD trainings often include State officials and local response forces such as the police.	<b>Less applicable to slow-onset environmental changes</b> These trainings focus on natural disasters or sudden events. Sea-level rise, land subsidence and coastal erosion are not recognized as emergencies unless flooding is severe.
<b>Complementary forms of income</b>	Village members look for alternative forms of income that do not heavily rely on the availability of natural resources to complement incomes from resource-dependent activities. Alternative sources of income include moto taxi driving, mangrove restoration, managing small shops and becoming factory workers.	<b>Livelihood threat remains</b> These alternative sources of income do not guarantee economic security or decent work opportunities. In cases where alternative sources of income are not available, affected individuals may resort to more vulnerable forms of employment or employment in the informal sector. More importantly, most village members remain living in high-risk areas.
<b>Gotong royong</b>	<i>Gotong royong</i> refers to solidarity and togetherness among village members, manifested in the aftermath of <i>rob</i> in the form of neighbours helping one another, cleaning and repairing, and in voluntary fee donations to adaptation initiatives.	<b>Highly dependent on village demographics</b> Sustainable sources of income are required to support effective long-term village-level adaptation strategies.
<b>Migration</b>	In cases where there is permanent land loss or significant livelihood impacts, individuals and communities are resorting to irregular migration as an adaptation strategy.	<b>Irregular migration: Numerous barriers and increased vulnerabilities</b> When individuals, households or communities decide to migrate, they may experience economic, social and land-related barriers and constraints. In addition, without strategies to enable orderly and safe migration, environmental migrants may experience increased vulnerability.

The ability to implement these strategies depends on financial resources, access to information, educational attainment, health, social resources, existing infrastructure, technology, gender and age, among other factors. While these adaptation measures can alleviate the impacts of environmental phenomena, they are often implemented in an ad hoc and reactionary manner that may undermine their effectiveness.

## Environmental migration: Enablers and constraints

Indonesia's geographic, socioeconomic and demographic characteristics interact with climate-driven hydrological phenomena, resulting in negative livelihood impacts. In turn, these negative livelihood impacts, as well as permanent land loss, can act as drivers of environmental

migration, as people seek alternative income-generating opportunities and places of residence. While integrated adaptation measures may reduce the drivers of environmental migration, in some cases, livelihood impacts and permanent land loss may be too severe, leaving migration as the only viable option.

The findings from the semi-structured interviews – as described with Table 1 – show that migration paths and destinations taken by the migrants are diverse. In some cases, migrants moved further inland while remaining in the same district or village. In other cases, migration patterns were dependent on employment opportunities. Social networks are also a significant factor in establishing migration patterns, as several migrants reported moving to areas where they had familial ties or existing networks. In most cases, migrants moved from peri-urban areas to either urban or other peri-urban areas.



Findings also suggest that environmental migration in Java – unlike other forms of internal migration – takes place as a collective process where households, and in some cases, entire communities migrate together. While in some cases of permanent land loss communities have been granted access to land for resettlement, environmental migration tends to take place spontaneously and irregularly in the absence of policy and migration governance frameworks that facilitate safe, orderly and regular migration. Well-managed migration can reduce environmental migrants' vulnerabilities and facilitate their contributions to sustainable development.

The following section outlines economic, social and land-related enablers and constraints that impact the population's ability to migrate. These findings provide initial insights to inform policymakers on how to support environmental migrants and facilitate safe, orderly and regular migration where necessary.

### Economic enablers and constraints

**Economic resources:** Migrants need to have sufficient economic resources to cover the costs involved in the process of migration (such as transportation and new living arrangements). In Bekasi, interviewees referenced economic constraints as main reasons for moving or failing to move. In the words of one interviewee, "I have thought to move back to Indramayu, but I have the same problem; it's a financial matter. I don't really have the money to move." Similarly, one member of Puspita Bahari expressed that she and her family "really want to move, but don't have the financial capability". On the other hand, having economic resources enabled individuals not only to migrate to low-risk areas but, in some cases, to develop risk mitigation strategies. This was the case for Panggung Lor, where "Most of the people have better economic condition than other communities [so] they have good resilience and could do it [build pumps] collectively". Those who can migrate tend to be more economically well-off than those who stay, and savings often play an important role in enabling migration and facilitating the implementation of risk mitigation strategies. In addition, the ability of landowners to sell land, or to buy land in host communities, can play a role in determining whether households have enough resources to migrate.

**Transferable skills:** Low-skilled migrants tend to be among the most vulnerable groups in society and are often unable to migrate because they lack education or vocational skills required to find employment (Asian Development Bank, 2012; Warner, 2010). Low-income individuals who derive their livelihoods from natural

resources often lack transferable skills and are either unable or unwilling to migrate, despite deteriorating livelihood conditions. In Semarang, interviewees indicated that migration was a "last option" because they consider that migrating will result in income loss, as their livelihood is tied to the surrounding natural resources.

**Employment opportunities:** Access to employment opportunities is a key driver for migrants. In Bekasi, interviewees shared, "Those who decided to move, it's usually because they have a job contract." One interviewee specified, "For people who moved to Borneo in a palm oil company, they already have housing for them". It is because of the contract that they decided to move. Those unable to migrate indicated that "the most important thing is a proper job". Many of the individuals who migrated without social networks or economic resources did so only after having secured a job contract, especially in areas where livelihoods and incomes deteriorate incrementally as opposed to as a result of sudden-onset events.

**Gender** also plays a role in having skills and the opportunities to migrate. This issue is particularly salient for women in low-income coastal communities. The founder of Puspita Bahari indicated, "Women in fishing communities are very much constrained in access to education and other forms of information [as] every decision is dominated by men."

### Social enablers and constraints

**Social networks:** Social networks are key to finding opportunities, housing and resources elsewhere, as migrants tend to move to places where they have existing social ties or follow previous migrants from their own villages. As one interviewee explained, individuals "migrate because of the networks from their neighbourhoods or friendships. The networks of people who have been working in that sector or who know about the job. This same network usually helps with housing too [as] they usually migrate in groups, families." Networks in Indonesia exist not only between people from the same villages, but include ethnic and familial ties, resulting in a large and complex web of connections. In addition to being a key factor in enabling or constraining migration, social networks can also provide an entry point to help determine environmental migration patterns.

**Gotong royong:** *Gotong royong* enables migration as it encourages villagers to help each other in the process and facilitates collective action to migrate. In Demak, interviewees reported helping each other in the moving process by taking turns to use the boats a

few community members owned. Similarly, in Bedono, interviewees reported helping each other move after “abrasion (coastal erosion) came”. This same solidarity and togetherness also present a constraint to migration, as it deters individuals from migrating even when their livelihoods have been severely affected. Despite constantly experiencing *rob*, interviewees in Bekasi felt a sense of responsibility towards their neighbourhood. The “obligation to take care of this place”, as one of them put it, acted as a deterrent to move away.

## Land

The availability of land and land prices act as significant enablers and constraints for environmental migrants, especially those whose livelihoods directly depend on the resource economy. Securing land in the host community is often a priority, and depreciating land prices in affected communities mean that individuals are unable to sell their land and migrate. As an interviewee in Bekasi put it, “Not a lot of people would buy a land affected by abrasion (coastal erosion)”. In cases where individuals cannot sell their lands, they are forced to “abandon their homes because they cannot really sell the land”.

Where villages have moved due to permanent land loss resulting from land subsidence and coastal erosion, they have done so collectively. In these cases, the Government facilitated access to any available nearby unused land. Communities then collectively migrate and begin the process of resettling and building infrastructure. In some cases, the land granted for the resettlement process has also been in marginal, vulnerable areas, meaning that villages continue to be exposed to a series of environmental hazards.

## Recommendations

The combination of land subsidence, coastal erosion and sea-level rise are already affecting income-generating activities, driving families and communities to develop short-term adaptation strategies, and, when faced with irreversible damage and/or permanent land loss, affected individuals see migration as the only choice. Environmental migrants experience a series of barriers, including availability of land, deteriorating land prices and the lack of financial and social capital, employment opportunities and transferable skills. The section that follows describes key areas to address in order to ensure that environmental migration is safe, orderly and regular.

## Integrated long- and short-term adaptation measures

Government agencies and organizations working on adaptation should adopt a more integrated approach to adaptation by implementing both short- and long-term adaptation measures that are based on existing best practices and local realities. These interventions should particularly target high exposure and at-risk areas, while prioritizing low-income and irregular settlements where households may have less adaptive capacity. Furthermore, adaptive capacity may be improved by replicating best practices, such as the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) village-level communication strategy and the coordinated actions of the Community of the Mitigation and Control of Pangung Lor Rob (P5L). BMKG uses WhatsApp groups to disseminate information on *rob* and tides to individuals in urban coastal villages, which allows them to prepare for flooding and take the necessary precautions. P5L has managed to improve DRR practices, involve the community in flood management, and install and operate a comprehensive pump and drainage system. The organization has gained national recognition, and its model presents opportunities for replication.

## Improved land use planning

Relocation policies and programmes should ensure that, when relocation is necessary and there is a consensus with the affected population for relocation, the population should be relocated to areas that can provide them with real livelihood options, including employment opportunities and access to basic services. Furthermore, Indonesia is already experiencing rapid rates of urbanization, including in coastal cities and LECZs. Future land use planning must ensure that infrastructural development takes place in areas with low exposure to hydrometeorological phenomena and considers scientific projections of sea-level rise.

## Livelihood diversification

Long-term adaptation strategies should focus on expanding the population’s skill base through educational services, workshops, trainings, cooperatives and creating employment opportunities in different economic sectors. The expansion of transferable skills should reflect current and future job market growth and national economic priorities. Expanding the affected population’s skill base would allow them to diversify their income and reduce their direct dependence on natural resources.

## Community-based policy formulation and implementation

The policymaking process should be based on consultations at the village level and ensure that the voices and experiences of the most vulnerable groups – including religious minorities, women, youth and the elderly – are included and that their specific needs are met. In the case where migration becomes necessary, affected persons should be consulted and participate in determining the process of relocation. Policymakers can take advantage of existing social structures, including *musyawarah* and *gotong royong*, to effectively include individuals at the village level in the decision-making process.

## Improved coordination and integration

Adopting effective adaptation measures necessitates coordination and collaboration across different governmental institutions to ensure that they effectively address the needs of affected populations. Concretely, this means the following: (a) greater integration of adaptation measures into larger development policies and DRR frameworks; (b) joint planning and clearly defined roles among government agencies and international, national and local organizations working on the areas of adaptation, DRR and development; and (c) greater collaboration with non-State and local actors including academic institutions and community organizations.

## Continued research and data collection

Greater collaboration with research institutions is of importance to identify the most vulnerable areas and populations. There is a need for continued research on migration, environment and climate change to formulate appropriate responses and adaptation strategies. Empirical evidence should be based on the experiences of the affected populations and migrants (considering

different population groups including women, youth, elderly, disabled, ethnic and racial minorities) to understand the local dynamics and impacts of climate change. Quantitative data on climate and environmental change should also be prioritized in national development plans to identify trends and better target interventions. Improved data collection can also help identify emerging patterns of environmental migration and inform policies and programmes to enable safe, orderly and regular migration.

## Conclusion

The research clearly shows that slow-onset hydrometeorological phenomena are already threatening the livelihoods of communities in LECZs. In particular, the combination of sea-level rise, land subsidence and coastal erosion is increasing the frequency and intensity of *rob*, which in turn affects income-generating activities. While affected individuals implemented a series of adaptation strategies, these only address immediate and short-term needs. They will not prevent permanent land loss and related irreversible damages. Communities and families faced with permanent land loss and significant livelihood impacts have been forced to move without support from appropriate strategies to ensure safe, orderly and regular migration.

In order to take advantage of the multiple benefits of migration, migration as adaptation should be included in national and local development plans and climate change adaptation strategies. The implementation of these plans should enable migration and reduce the existing constraints when community members, households or individuals decide to pursue it as an adaptation strategy to climate change. In these cases, development plans must ensure that environmental migrants have access to secure livelihood options in their host communities.



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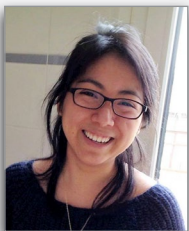
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