

CLIMATE CHANGE VULNERABILITY ASSESSMENT

KUPANG CITY

JUNE 2015



KOTAKITA
A CITY FOR ALL

This document was prepared in partnership with United Nations Development Programme Indonesia's - Safer Communities Through Disaster Risk Reduction (UNDP-SCDRR), Yayasan Kota Kita (Our City Foundation), and City of Kupang Government.

Published by the United Nations Development Programme- Safer Communities Through Risk Reduction (UNDP-SCDRR) and Yayasan Kota Kita

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Figure 1: Lying along the coast means that Kupang City, its inhabitants and its economy are exposed to sea-level rise, the changing seasonality of fishing, and abrasion.

1. Introduction

a. Climate change in Indonesia today

Climate change is affecting communities throughout the world and its impact is becoming increasingly evident in cities across Indonesia. Climate change-related hazards, such as rising sea-levels, coastal flooding, landslides, droughts, and storm surges, are having widespread negative effects upon people, such as damaging their homes, businesses and infrastructure, and disrupting their economies and ecosystems. What is particularly worrisome is that climate change intersects with another important trend, *urbanization*, and together they are creating additional risk and vulnerability for many communities.

Urbanization in Indonesia is occurring rapidly. Cities now house over half of Indonesia's population and they concentrate a large part of the country's assets and economies. But as cities grow, so do highly vulnerable communities; as people are drawn to cities for jobs and better futures, they are often unable to find homes and livelihoods in safe areas. As a result, they are forced to live in informal settlements and hazardous areas that lack infrastructure and services.

These communities are particularly at risk of climate change, and they are the subjects of this Climate Change Vulnerability Assessment (CCVA).

b. Background

The CCVA for the City of Kupang is being carried out at the request of the United Nations Development Program's Safer Communities Through Disaster Risk Reduction in Development Program (SC-DRR). It is a collaborative research process facilitated by the local Indonesian NGO Yayasan Kota Kita, together with the City Government of Kupang and local civil society organizations. The current report forms one part of SC-DRR's Urban Climate Risk Management Program (UCLIM) which also includes the creation of an Urban Risk Management Plan for Kupang City.

The process of creating this report has been participatory and also pedagogic, it has sought to bring together key city officials and stakeholders, to educate them about the impacts of climate change, and identify how it makes their city vulnerable. Thus methodology has involved the gathering and discussion of local knowledge and data, visiting local communities, and a collaborative analysis to identify the city's most vulnerable people, places and

urban systems. The process itself has consisted of two workshops involving city stakeholders, site visits and focus group discussions, and a consultation with government officials.

The Vulnerability Assessment proposes both qualitative and quantitative approaches to evaluate and identify vulnerability in Kupang City. We developed these approaches taking into account both the challenges of collecting sufficiently fine-grained comprehensive data, as well as the complex, anthropological nature of the social, economic, and political phenomena underpinning the city's vulnerability measures. This report seeks to balance a range of perspectives, and can serve as an educational tool for stakeholders.

The assessment aims to be accessible, visual and explanatory, and enable the reader to understand the methods and analysis clearly. Maps, diagrams

and explanatory text are used to help the assessment communicate findings. There are seven chapters in this assessment: following this introduction, Chapter 2 helps the reader understand city context, the range of issues it faces, and trends it is experiencing. Chapters 3 and 4 look at understanding Exposure and Sensitivity and explain how these features of the city contribute to vulnerability. Chapter 5 demonstrates what the city is currently doing to reduce vulnerability through programs and policies that promote adaptive capacity, but in turn identifies where it is low. Chapter 6 reflects upon the different perspectives that one can view climate change vulnerability by identifying specific people, places and critical urban systems. Finally Chapter 7 puts forward a number of recommendations that the city can take forward to reduce vulnerability and build resilience to climate hazards in the future.

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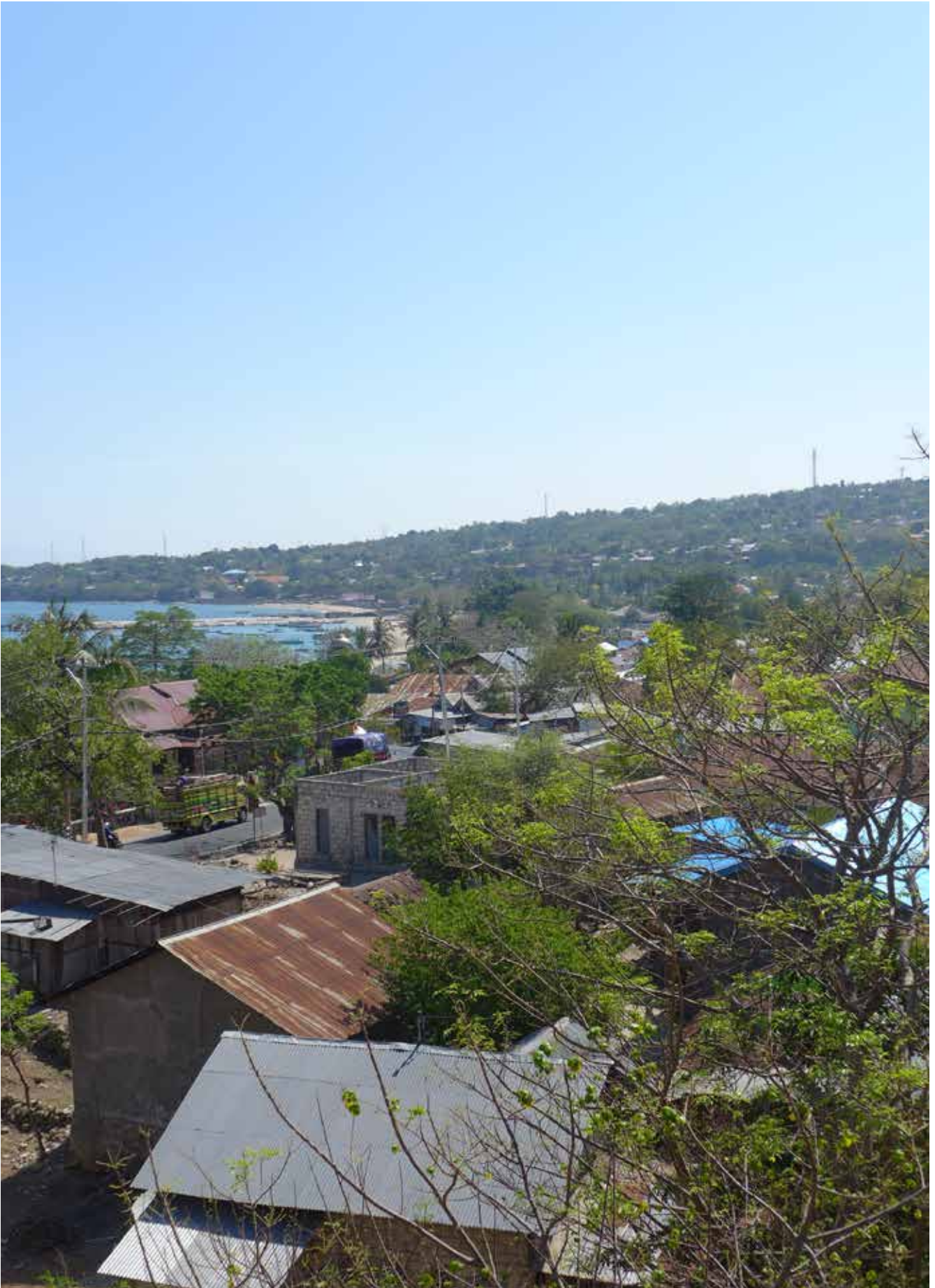


Figure 2: The city of Kupang is growing rapidly. The population growth rate from 2011-2012 is 4,58% which shows massive growth of the city. To handle this rapid development, the government should anticipate by providing adequate infrastructure like housing, roads, water as well as create economic development opportunities for the people.

2. Kupang Today: The City's Context

a. Urbanization

The City of Kupang is growing rapidly. The population is estimated to double in fifteen years, from 378,425 to just over 750,000. Urbanization is being driven by the large-scale immigration of people from rural areas of Timor, as well as from neighboring islands. These people are drawn to Kupang City to find jobs and opportunities, or perhaps to escape droughts or other situations of risk— but certainly to seek a better life.

Cities like Kupang City can provide these opportunities, and make it easier to access education, markets and basic services. They can also provide stability and safety. However, they can also increase vulnerability as people may be forced to live in areas that are exposed to risk, or because their jobs are precarious. This chapter will provide some insight into the current situation of the city, and also indicate what are some trends that are shaping its future. By considering the critical issues we can begin to understand how different places and communities face different risks, and thus expose people to vulnerability.

KUPANG FACTS

365,356

Population

15.90%

%HH in Poverty

Source: Population by BPS, Poverty rate by TNP2K

GENERAL PROFILE

Total Land Area	16,534 ha
# of Districts	6
# of Neighborhoods	51
# of Household	66,763
Population Density	26 people / ha
Population growth (2011 - 2012)	4.58 %

ECONOMY

Economic Sectors (% of GDP in 2013, BPS)

Agriculture	3.8%
Manufacturing	1.4%
Processing Industries	2.4%
Utilities	0.9%
Construction	10.1%
Trade, Hotel, Restaurant	29.0%
Transportation and Communication	15.5%
Finance & Business Services	5.7%
Other Services	31.0%

KUPANG AND EAST TIMOR REGIONAL NETWORK

As the capital city of the province, Kupang is well-connected to regional roadway infrastructure to some region, as well as to other country, Timor Leste. The city also connects to other region in different islands by trough airport and cruise port.



b. Demography

Demographic information informs us about the characteristics of the population. We can use it to understand where people live and how fast the population is growing. Understanding demographic change is important because some areas of the city are growing faster than others, while some areas have very few people that work or live there. By understanding the changing nature of cities, the City Government can better respond to changing needs or situations; for example, knowing that different areas face different issues and need different policies and planning.

Kupang City is growing by 4.6% each year. This is significantly higher than the growth rate of the rest of Indonesia, which is growing at a rate of 1.04%. As mentioned earlier, newcomers come from other areas of Timor, and islands such as Rote, Sumba— even Flores and Lombok.

Where they go depends on a number of factors, such as their backgrounds, ethnicity and their skills and profession. For example, those people who work as laborers, might want to move to areas near construction sites or markets; whereas people who are fishermen or dockworkers want to move near the sea or the port.

POPULATION NUMBERS OF KUPANG CITY

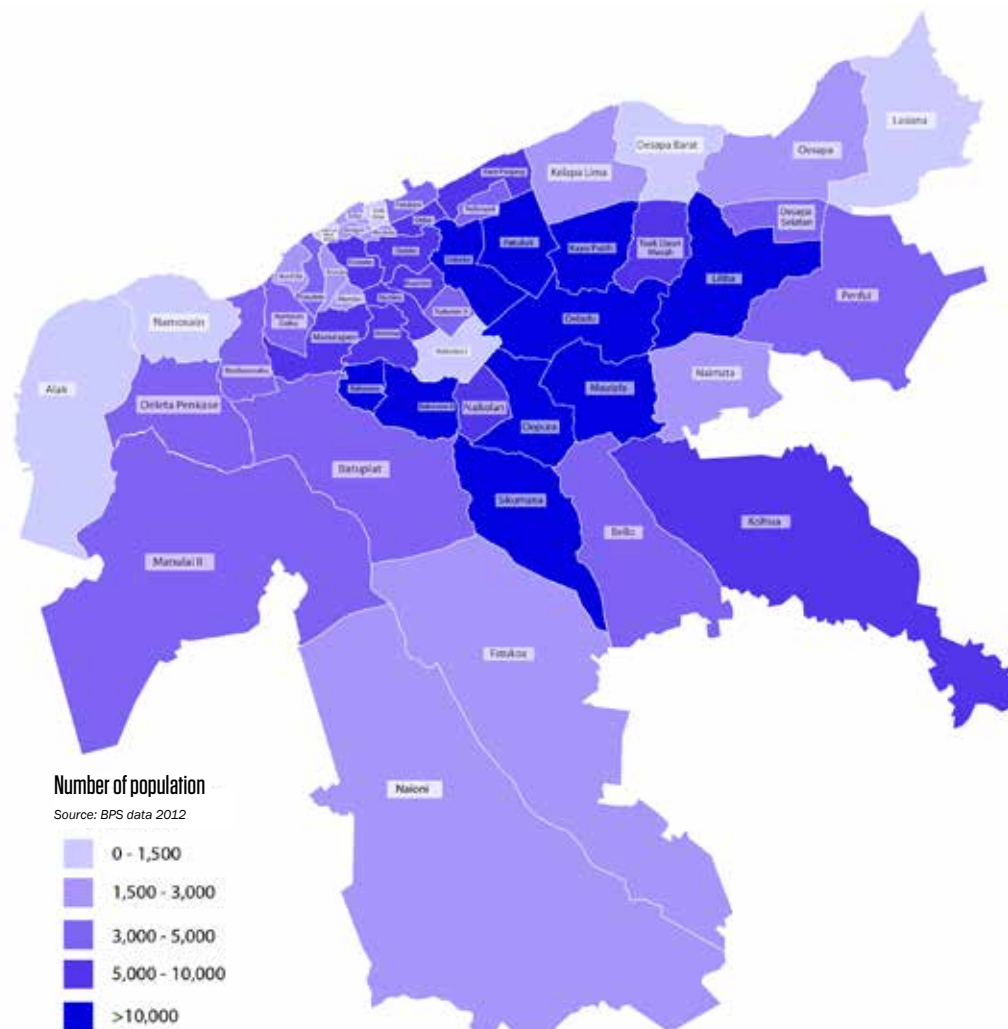


Figure 3: The neighborhoods, or *Kelurahans*, with high overall numbers of population are those in the center and east of the city such as Oebofu, Fatulili, and Oepura.

POPULATION DENSITY OF KUPANG CITY

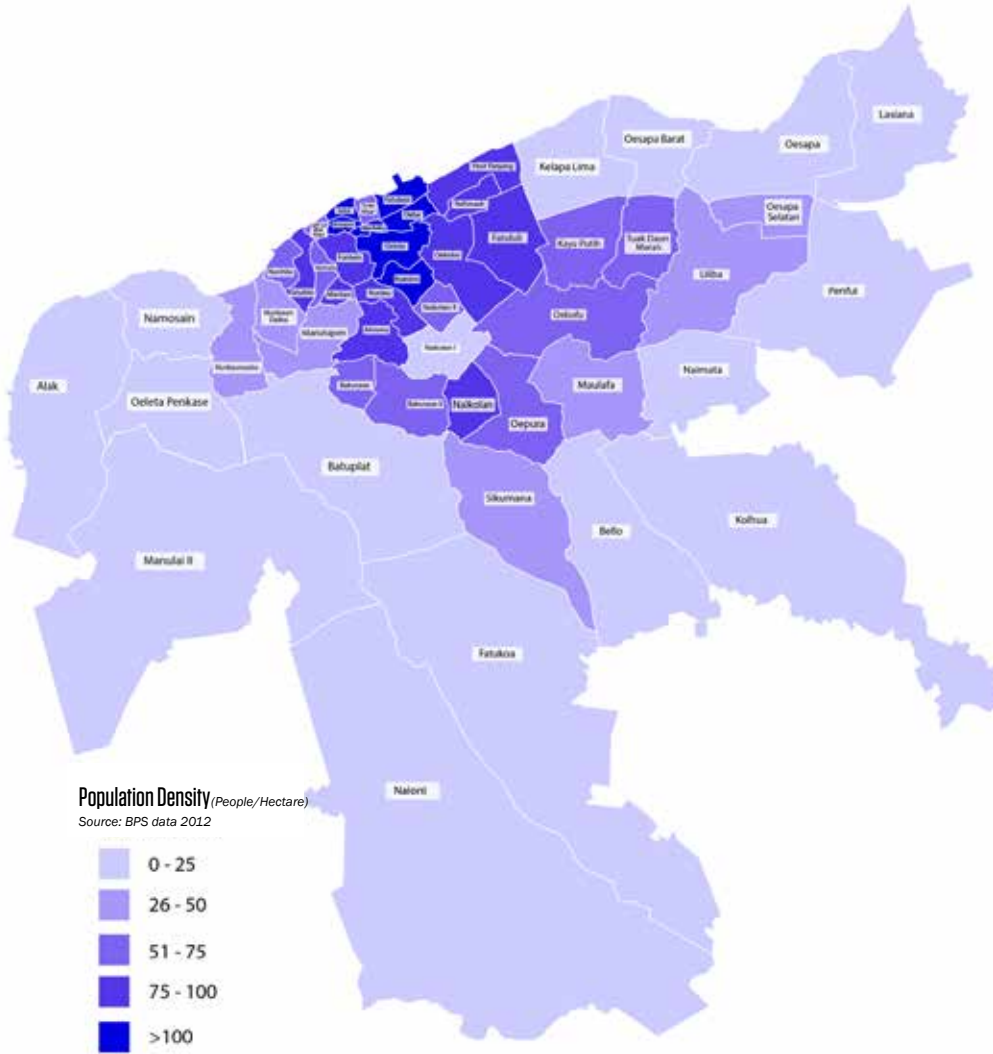


Figure 4: The neighborhoods with highest population density (population per hectare) are those in the old part of the city along the coast, such as Fatubesi, Oeba and Solor.

From the two maps we can how the population of the city is distributed. The population map (Fig. 3) shows how people are distributed in different neighborhoods, while the population density map (Fig. 4) indicates the concentration of people in relation to area. Density is different to pure numbers of people because it denotes how close together they live. The higher the density the greater the demand for services and more concentrated issues can be.

The population is growing most quickly in the periphery of the city and along the coastline (Fig. 13). These areas are attracting people who seek jobs and land for their homes. For example, in the neighborhood of Alak, near the port, many people come to find jobs in factories and warehouses, and because there is a lot of land to build homes. In the east of the city you also have high population growth too, but these people are seeking to live near the coast and may have different skills.

c. Jobs and Economic Growth

Businesses and people are drawn to Kupang primarily because of economic opportunities, either to find employment or to do business. Kupang is the economic center for the Nusa Tenggara Tengah (NTT) region, at the moment it is thriving with new hotels, shops and buildings being built and opened every day. This is very good for the city because it contributes to people's livelihoods and improves living standards. But it is also important to ensure that these businesses are sustainable, meaning that they will continue for some time, and also that they generate employment and opportunities for lots of people.

The hotel, services and trade sectors are a growing rapidly, and represent about 60% of the city's economy. There are many new hotels that are being built in the city, and this is supporting the local economy by attracting visitors and creating jobs. But they are also located along the coastline, and these areas suffer from climate change. They may also be in areas where other communities are already located, and prevent access to beaches and sea by the public and fishermen.

Based on data gathered between 2010 and 2013, the economic sectors which perform slightly better are (1) Services, which increased from 29,10% in 2010 to 31,02% in 2013; (2) Trade, hotel, and restaurants, which increased from 28,85% in 2010 to 29,01% in 2013; and (3) Electricity, gas, and water supply. Agriculture has decreased (from 4,42% to 3,85% in 2013) perhaps due to the real estate development in the southern part of the city where agriculture land is being converted.

Unemployment is a problem for the city because unemployed people are more challenged to contribute economically to their households. High unemployment means there will be a large informal sector and likely high levels of poverty. Unemployment is especially troublesome for young people, and many are concerned that there are no jobs available except driving an ojek, for young men, or being a shop-keeper, for young women.

ECONOMIC SECTORS 2013

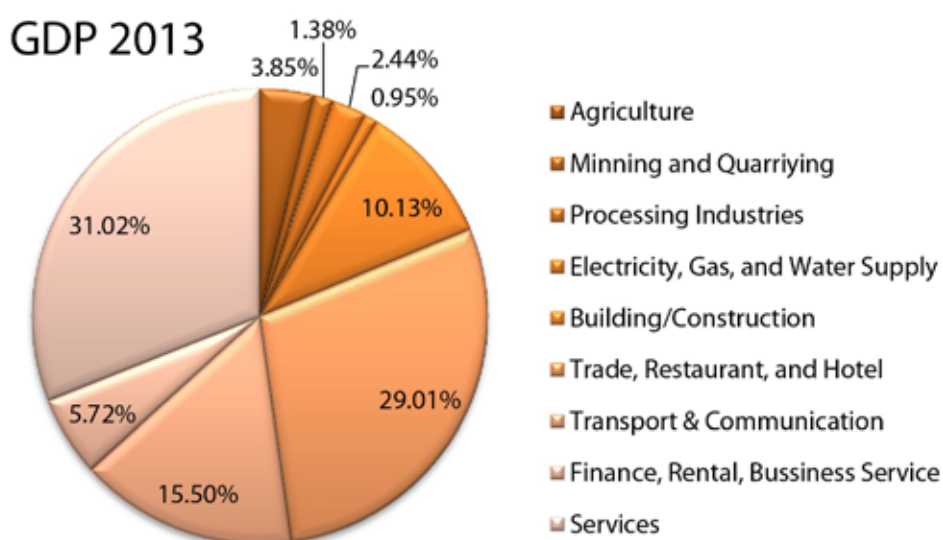


Figure 5: The economy of Kupang City depends largely on the service sector, such as hotels and restaurants. But the poor sectors of the population work mostly as farmers, fishermen, as informal traders and small scale industries.

d. Public Service Delivery

The public relies on the city for a number of public services, such as water, trash collection, health care, transportation, and education. Delivering public services is very challenging because the government has financial and administrative limitations, and because the city is constantly evolving and growing. Sometimes there are not enough teachers or school desks for children because the area of that school grew so quickly and there was no time to make adjustments.

Improving the delivery of public services is an important way of improving lives, reducing poverty, and creating opportunities and prosperity. Local governments should therefore identify areas that lack services, with particular attention to informal, fast-growing, poorer communities, and find solutions. This can also help reduce vulnerability to climate change and build resilience.

Mapping where public services are currently provided, and comparing these maps to maps of demography, poverty and urban trends, can help to identify priority areas where people need critical services. It can also help us anticipate the need for improvements in the future.

Water

- WATER IS ESSENTIAL FOR HUMAN LIFE, BUT ALSO FOR AGRICULTURE AND INDUSTRY. THEREFORE, IT IS PERHAPS THE MOST IMPORTANT PUBLIC SERVICE A GOVERNMENT CAN PROVIDE. IN KUPANG WATER IS DELIVERED EITHER BY THE PROVINCIAL PDAM, AND/OR THE NEWLY FORMED CITY PDAM. THERE IS MORE DEVELOPED WATER SUPPLY INFRASTRUCTURE (PIPES) IN THE CENTER OF THE CITY, AND MUCH LOWER ACCESS TO THE SOUTH, WHICH IS AT A HIGHER ELEVATION.
- BECAUSE OF SHIPMENT COSTS, LOWER-INCOME FAMILIES OFTEN PAY MOST FOR WATER. THIS IS PARTICULARLY DIFFICULT DURING THE DRY SEASON WHEN WATER SCARCITY IS AN ISSUE.

WATER SERVICE DELIVERY MAP

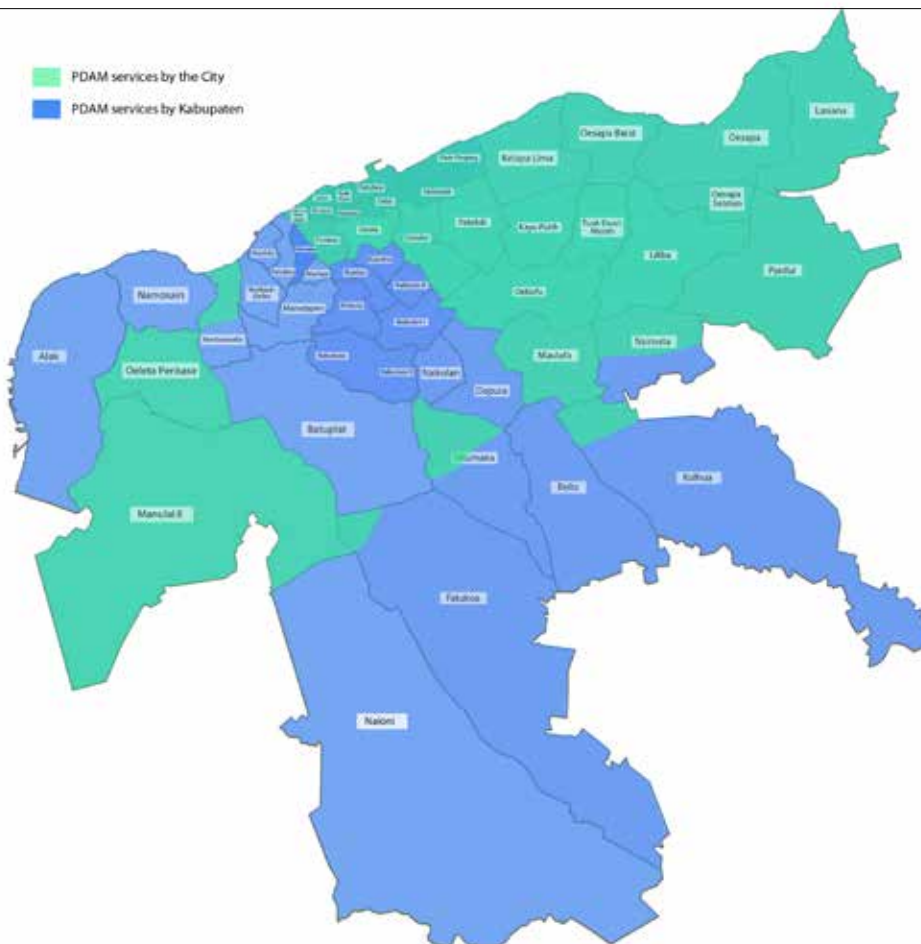


Figure 6: Water supply in the city is distributed either by the District of Kupang PDAM or the City of Kupang PDAM; there is no indication why certain neighborhoods may be under the jurisdiction of one rather than the other.

- IN MOST HOUSEHOLDS, WOMEN ARE RESPONSIBLE FOR SUPPLYING WATER. WHEN THESE WATER SOURCES ARE NOT AVAILABLE, WOMEN MUST SEEK ALTERNATIVE SOURCES. THIS TAKES MORE TIME, MONEY, AND PHYSICAL EFFORT TO TRANSPORT WATER FROM MORE DISTANT LOCATIONS. OLDER PEOPLE AND CHILDREN ALSO ARE CHARGED WITH CARRYING WATER TO THEIR HOMES.
- OUR RESEARCH FOUND THAT IN KELURAHAN AIRNONA A HOUSEHOLD SPENDS AROUND IDR 130.000 FOR 5,000 LITRES OF WATER DURING THE DRY SEASON (TRUCK DELIVERY). THIS IS REFILLED 2-3 TIMES A MONTH (APPROX. IDR 260.00 – IDR 390.000). CONSIDERING THE NATIONAL POVERTY LINE IS IDR 425.000, THE VERY POOR HAVE TO SPEND BETWEEN 61.17% AND 91.76% FOR WATER.

Energy and Electricity

- MOST OF THE CITY HAS ELECTRICITY, EXCEPT FOR FATUKOA AND NAINONI, WHERE SUPPLY IS LIMITED. LACK OF ELECTRICITY CAN MAKE POORER COMMUNITIES ESPECIALLY VULNERABLE BECAUSE THEY CANNOT USE APPLIANCES SUCH AS LIGHTING.
- IN EXPANDING ENERGY RESOURCES AND SERVICES, LIKE ELECTRICITY, IT IS IMPORTANT TO MAKE SURE THAT THESE SERVICES REACH THE MOST VULNERABLE POPULATIONS. THIS CAN BE ESPECIALLY DIFFICULT IN INFORMAL COMMUNITIES, BUT ALL THE MORE IMPORTANT TO ENSURE THEIR SECURITY DURING A STORM.
- GIVEN THE CHALLENGE OF PROVIDING SERVICES TO RAPIDLY URBANIZING INFORMAL COMMUNITIES, IT IS IMPORTANT THAT GOVERNMENT PRIORITIZE RENEWABLE ENERGY FOR FUTURE DEVELOPMENT. ACCORDING TO THE UNFCCC 2010 REPORT, THE ENERGY SECTOR IS IN GOVERNMENT'S TOP FOUR PRIORITY SECTORS TO STRENGTHEN AND MAKE MORE SUSTAINABLE.

Transportation and Access

- TRAFFIC IS NOT YET A PROBLEM IN THE CITY, BUT THERE ARE LARGE AREAS OF THE CITY, ESPECIALLY IN THE PERIPHERY, WHERE ROADS ARE NOT PAVED AND THIS MAKE ACCESS DIFFICULT.
- MANY PEOPLE RELY ON ANGKOTS FOR PUBLIC TRANSPORTATION, BUT THEY ARE NOT SAFE FOR WOMEN OR KIDS.
- IMPROVING KUPANG'S "CRITICAL INFRASTRUCTURE," OR ROADS, BRIDGES, AND PUBLIC TRANSPORTATION SYSTEMS, IS PARTICULARLY IMPORTANT IN THE EVENT OF AN EMERGENCY OR NATURAL DISASTER, LIKE CYCLONES OR STORM SURGES. IT IS IMPORTANT THAT ALL PARTS OF THE CITY HAVE ACCESS TO GOOD ROADS IF EMERGENCY EVACUATION IS NECESSARY.

Health and Sanitation

- THE MOST COMMON HEALTH ISSUES IN KUPANG ARE ACUTE RESPIRATORY INFECTION (ARI), AND OTHER RESPIRATORY DISEASES. WATER SCARCITY AND SANITATION IS RESPONSIBLE FOR MANY OF THESE HEALTH ISSUES, AS PEOPLE ARE FORCED TO USE CONTAMINATED WATER FOR COOKING AND CLEANING. THESE HEALTH PROBLEMS AFFECT THE POOR IN PARTICULAR WHO HAVE DIFFICULTY ACCESSING WATER.
- THERE IS CURRENTLY NO INTEGRATED SYSTEM TO MONITOR SANITATION. WATER TESTING IS NOT A REGULARLY PROVIDED PUBLIC SERVICE, ALTHOUGH WATER SOURCES (LIKE WELLS AND STANDPIPES) ARE OFTEN CONTAMINATED.
- ALTHOUGH KUPANG HAS A TRASH COLLECTION SYSTEM, THE SERVICE DOESN'T REACH MANY PLACES AND OFTEN DOESN'T WORK. THERE IS A LOT OF TRASH AROUND THE MARKETS IN NAIKOTEN, FATUBESI AND KOLHUA, WHICH ARE NOT CONNECTED TO THE TRASH COLLECTION SYSTEM.
- IT IS ESPECIALLY IMPORTANT THAT WASTE REMOVAL IS IMPROVED FOR INFORMAL, POORER COMMUNITIES, AS DENGUE FEVER AND MALARIA ARE EXPECTED TO INCREASE WITH GLOBAL WARMING, AND THESE COMMUNITIES ESPECIALLY VULNERABLE.

CASE OF DISEASE IN KUPANG CITY

Case of Disease in Kupang

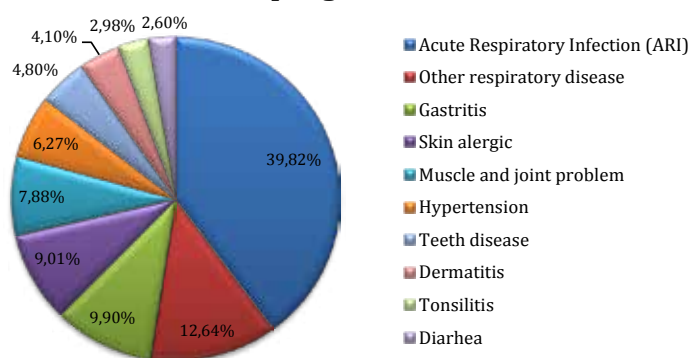


Figure 7: Acute Respiratory Disease is the most prominent disease in Kupang; improved access to infrastructure can help reduce vulnerability to these kinds of diseases.

e. Poverty

Poverty is a term that indicates a lack of material possessions or money. It is important to understand poverty because there are a number of factors that contribute to it. By understanding these poverty factors, we can also better understand why these communities are vulnerable to climate change, and offer solutions for reducing their vulnerability.

The poor are at risk because they often live in areas where they have less access to services, building materials, and employment, and on land that is at high risk from extreme weather. In order to protect them the government should better understand where these are located, and what special needs they may have.

The total number of poor families in Kupang is 22,326, but this is not distributed evenly. In some Kelurahan

the numbers are very high, for example there are 1,286 poor families in Oesapa. By looking at poverty as a percentage of the population we see another picture, where poverty is concentrated. In this case the Kelurahan with the highest concentration of poor are Nainoni three out of four families (74%), and Fatukoa (53%). This gives us a more accurate picture of how dominant the poor are in relation to other groups; in these areas there are likely to be fewer services as infrastructure, and more hazardous conditions. The poverty rate, or the percentage of the population that is considered poor is 27%, this is quite high compared to other Indonesian cities.

The total number of poor families in Kupang is 14,242, but this is not distributed evenly. In some Kelurahan the numbers are very high. For example, there are 824 poor families in Oesapa. By looking at poverty as a percentage of the population we see another picture,

PERCENTAGE OF POOR PEOPLE

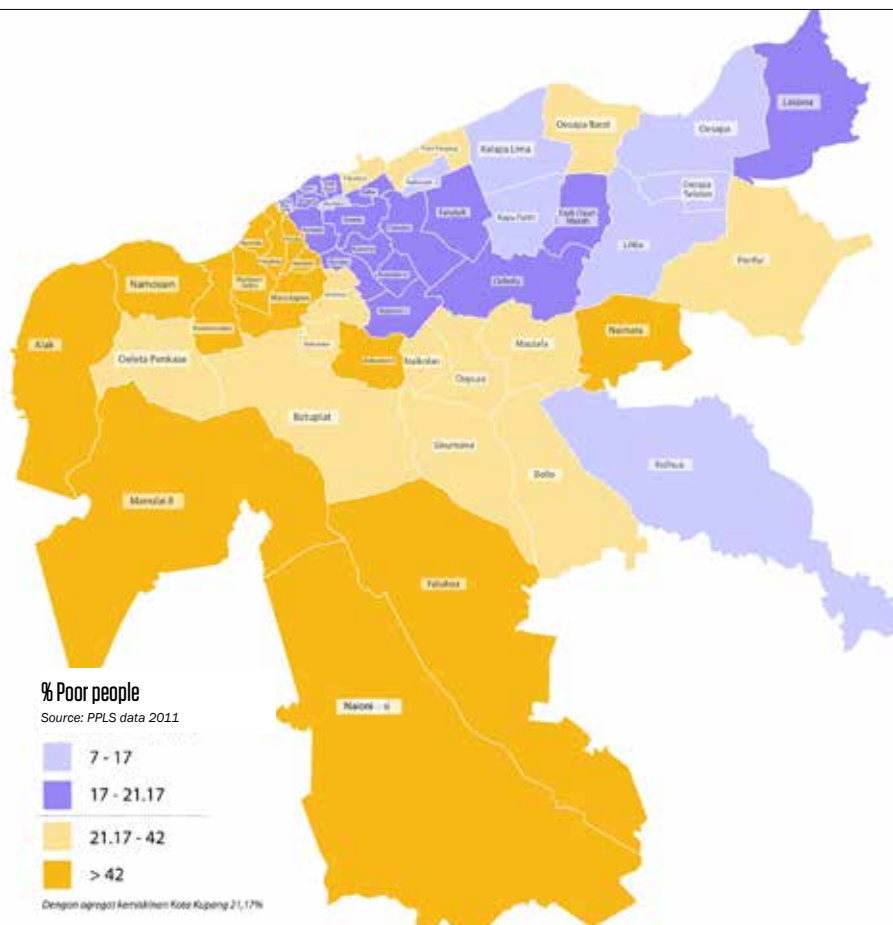


Figure 8: The poverty rate for the city is 21.17%, those neighborhoods where poverty is higher than the city average are mostly in the west. There are some neighborhoods where more than 42% of the population are living in poverty, these areas are particularly vulnerable to climate hazards.

where poverty is concentrated. In this case, the Kelurahan with the highest concentration of poor are Naioni one out of two families (52%), and Fatukoa (38%). This gives us a more accurate picture of how dominant the poor are in relation to other groups; in these areas there are likely to be fewer services as infrastructure, and more hazardous conditions. The poverty rate, or the percentage of the population that is considered poor, is 15.90%. This is quite high compared to other Indonesian cities.

There are three different kinds of poor people in Kupang: fishermen, farmers and traders or informal workers. Because of their jobs and where they live they have different vulnerabilities:

- FARMERS ARE VULNERABLE DUE TO THE THREAT OF URBAN DEVELOPMENT AND THE EXPANSION OF THE CITY. THEY ARE AT RISK OF LOSING THEIR LAND BECAUSE ITS VALUE HAS INCREASED SO MUCH AND MANY HOUSING DEVELOPERS ARE LOOKING TO BUY AND DEVELOP THEIR LAND. ALSO FARMING IS DIFFICULT WORK, AND WITHOUT A PROPER IRRIGATION SYSTEM IT'S A CHALLENGE TO MAINTAIN THIS PRACTICE YEAR TO YEAR.
- FISHERMEN ARE VULNERABLE BECAUSE THEY LIVE ON THE COASTLINE THAT SUFFERS FROM STRONG WAVES AND STORM SURGES THAT CAN DAMAGE THEIR BOATS AND HOMES. THE WEATHER ALSO IMPACTS THEIR LIVELIHOODS, IF DURING CERATIN PERIODS OF POOR WEATHER THEY CAN'T FISH THEIR FAMILIES WILL SUFFER FROM A LACK OF INCOME.
- TRADERS AND INFORMAL WORKERS ARE THE POOR THAT WORK IN THE CITY, THEY DEPEND ON EMPLOYMENT IN A RANGE OF URBAN SECTORS SUCH AS INFORMAL MARKETS,

NUMBER OF POOR PEOPLE IN KUPANG CITY

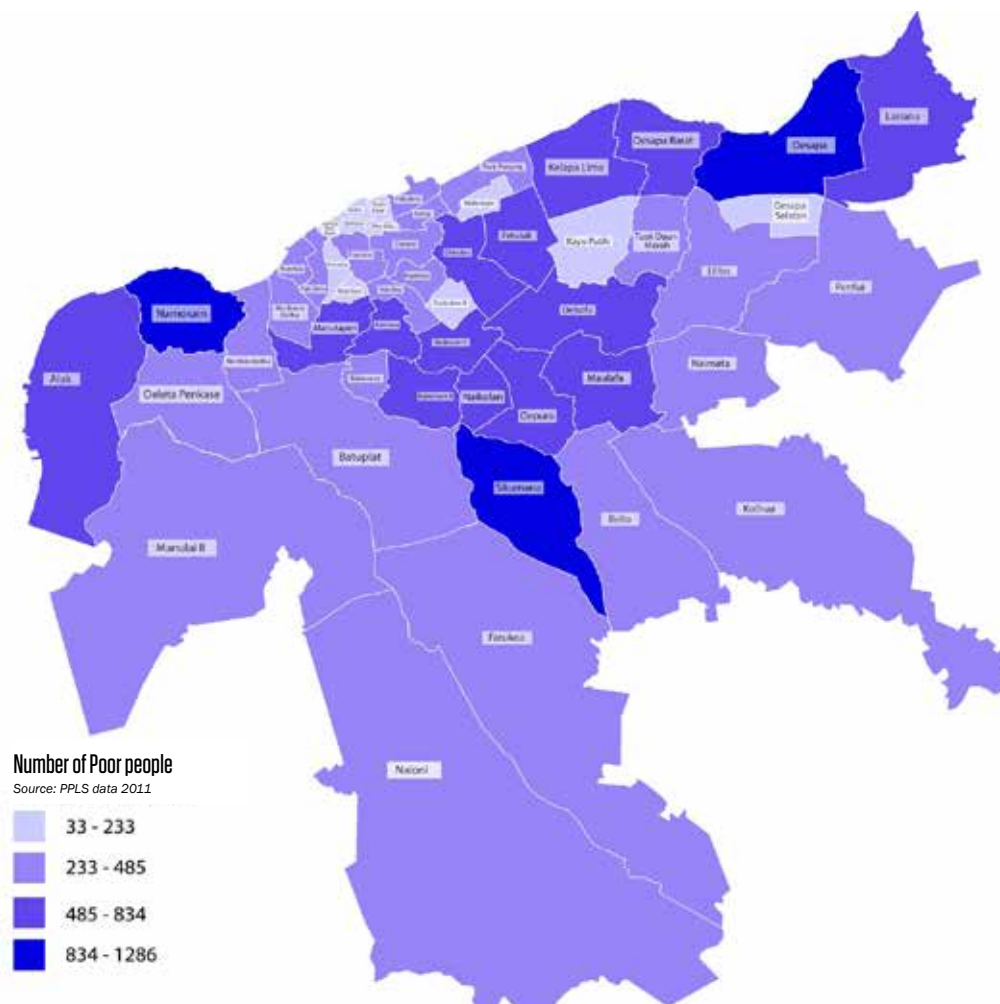


Figure 9: In terms of overall numbers the neighborhoods with the highest number of poor are Sikumana, Oesapa and Namosain.

THE 3 MAIN GROUPS OF POOR PEOPLE ARE LABORERS, FARMERS AND FISHERMEN



Figure 10: The city of Kupang is growing rapidly. The population growth rate from 2011-2012 are 4,58% which shows massive growth of the city. To handle this rapid development, the government should anticipate by providing adequate infrastructure like housing, road, water as well as create economic development opportunities for the people.

CONSTRUCTION AND MENIAL WORK. THEIR LIVES ARE DIFFICULT BECAUSE THEY CONSTANTLY SEEK LOW-SKILL EMPLOYMENT AND ARE OFTEN MARGINALIZED DUE TO THEIR LACK OF EDUCATION AND POOR SERVICES.

By understanding poverty the city government can better design policies and allocate funding, to target those people who most need it. Even small, but targeted, policies can help reduce vulnerability and have a big impact on their lives.

f. Ecosystems

Ecosystems are natural systems which play a vital role in providing the city with essential services that support its inhabitants. Rivers, for example, generate drinking water, while mangroves protect the coastline from dangerous winds and erosion that damage people's homes. Ecosystems don't require human inputs to function, but they do require conservation and maintenance. Some of Kupang's ecosystems are threatened by urbanization and are often not protected adequately. The most important ecosystems of the city are:

- **FORESTS AND PROTECTED AREAS** PROVIDE SHADE, GENERATE DRINKING WATER AND PRODUCE OXYGEN FOR US TO BREATHE. THE WATERSHED IS IN THE SOUTH, AND THERE ARE FORESTS ALONG THE RIVERS THAT RUN

THROUGH THE CITY. WHEN ADEQUATELY MAINTAINED, THESE CAN ALSO PREVENT LANDSLIDES.

- **MANGROVES** USED TO RUN ALONG THE COASTLINE BUT THEY HAVE BEEN SIGNIFICANTLY DEPLETED. THERE IS NOW ONLY ONE PROMINENT STRETCH FROM OESAPA TO OESAPA BARAT, WHERE THE MANGROVE IS STILL INTACT. MANGROVES NOT ONLY PROTECT AGAINST HIGH WINDS AND WAVES AND ABRASION, THEY ALSO PROVIDE REFUGE TO WILDLIFE AND PROVIDE EMPLOYMENT TO COASTAL COMMUNITIES.
- **RIVERS** ARE SIGNIFICANT BECAUSE KUPANG'S GEOLOGY MEANS THAT GROUND WATER IS DIFFICULT TO ACCESS, SO MANY PEOPLE RELY ON RIVERS AS THEIR SOURCE OF DRINKING WATER. RIVERS ARE THREATENED BY POLLUTION CAUSED BY SEDIMENTATION, WHICH IS OFTEN CAUSED BY EROSION AND DEFORESTATION OF THE WATERSHED, AS WELL AS FROM SEWAGE AND TRASH THAT CONTAMINATES RIVERS.

Protecting and maintaining ecosystems can be a valuable contributor to building urban resilience. This requires valuing their contribution to the city and enforcing regulations and policies that conserve them and allow them to function.

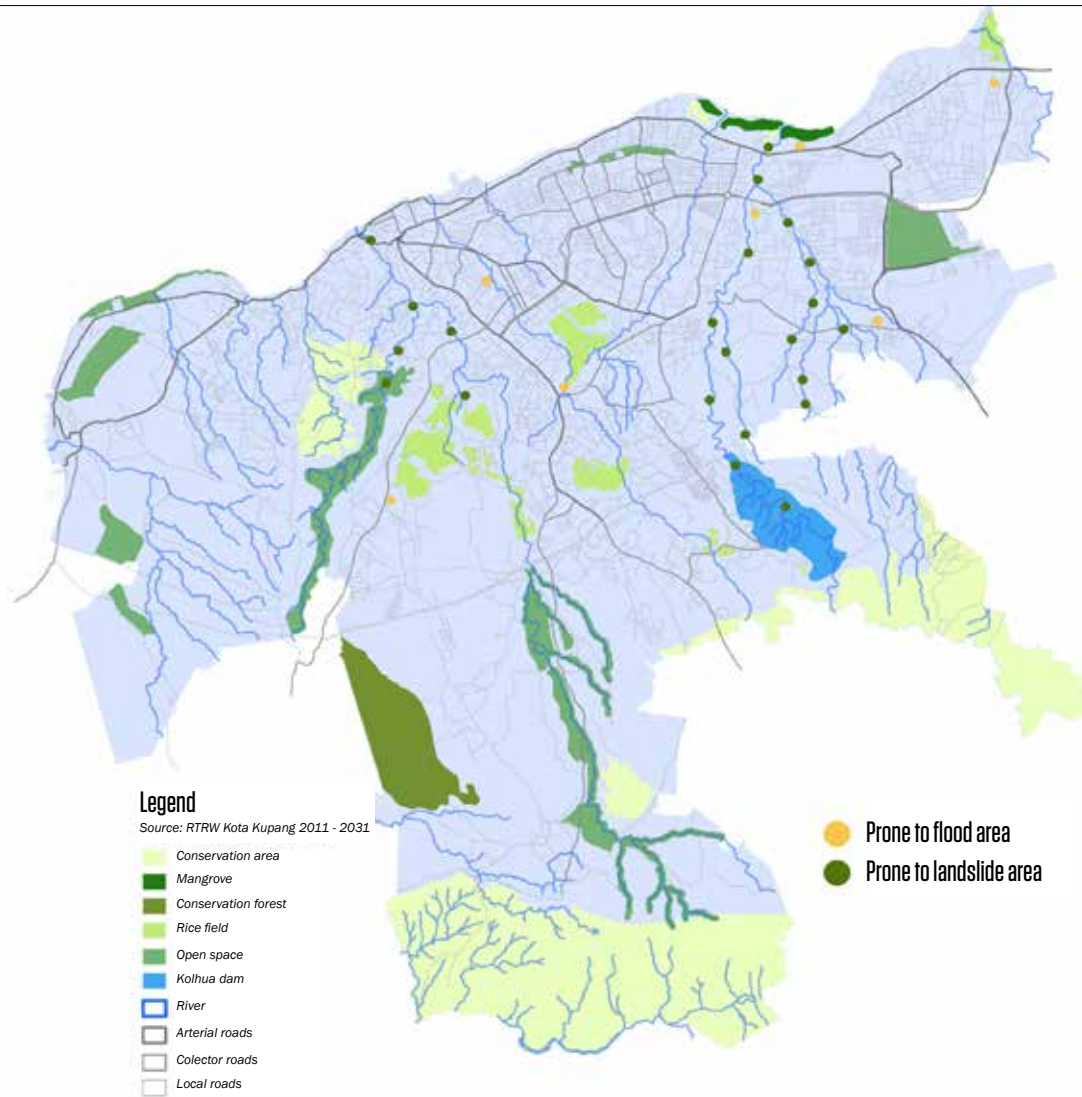


Figure 11: The city of Kupang has experienced a number of landslides along the rivers that run through it. There are a number of different ecosystems in the city today.

g. Disasters

In the past Kupang has suffered from a number of small-scale natural disasters and climate hazards. There have been many reported incidents of injuries and deaths caused by them. There have been four kinds of hazards that have been most dangerous: abrasion, landslides from heavy rains, high winds and droughts.

- **COASTAL ABRASION**

THE COASTLINE SUFFERS FROM HIGH WINDS AND BIG WAVES THAT CAUSE ABRASION. BEFORE THERE WERE MANGROVES THAT PROTECTED THE COAST, BUT NOW THERE ARE VERY FEW LEFT. ABRASION CAN DAMAGE AND

DESTROY HOMES AND INFRASTRUCTURE AND ERODE THE COASTLINE. THIS MOSTLY AFFECTS THOSE IN THE FISHING SECTOR, COASTAL BUSINESSES, AND PROPERTY OWNERS.

- **LANDSLIDES**

GIVEN THE STEEP HILLSIDES AND RAVINES IN SOME PARTS OF THE CITY, THERE ARE FREQUENT LANDSLIDES IN MANTASI AND BELO. LANDSLIDES OCCUR WHEN HEAVY RAINS CAUSE LAND ON STEEP AREAS TO COLLAPSE. THIS PROCESS IS ACCELERATED BY EROSION AND LACK OF VEGETATION CAUSED BY PEOPLE. WITH MORE AND MORE PEOPLE LIVING IN THESE AREAS THEY ARE BECOMING VERY DANGEROUS AND LANDSLIDES HAVE CAUSED INJURY AND DEATH, PARTICULARLY TO THE POOR.

- **HIGH WINDS**

ANOTHER FREQUENT HAZARD THAT OCCURS IN KUPANG IS HIGH WINDS. THESE CAN BE STRONG WINDS IN COASTAL AREAS LIKE OESAPA, OESAPA BARAT, AND FATUBESI, OR TORNADOS, WHICH OCCUR ON THE HILLSIDE AREAS LIKE BELO, FATUKOA, AND NAINONI. BOTH OF THESE WINDS HAVE INJURED PEOPLE, DAMAGED PROPERTY, AND POSE A CONSTANT THREAT DURING THE WINDY SEASON.

- **DROUGHT**

FARMERS, FISHERMEN, LABORERS ARE THE MOST VULNERABLE GROUPS TO DROUGHTS, AS OBTAINING WATER WHEN IT IS SCARCE IS COSTLY, TIME-CONSUMING, AND DIFFICULT TO TRANSPORT. ALAK, NAINONI, FATUKOA, KOLHUA, NAIMATA, LASIANA AND OELATA PENKASE HAVE ALL EXPERIENCED DROUGHT.

KUPANG'S DISASTER PRONE AREAS

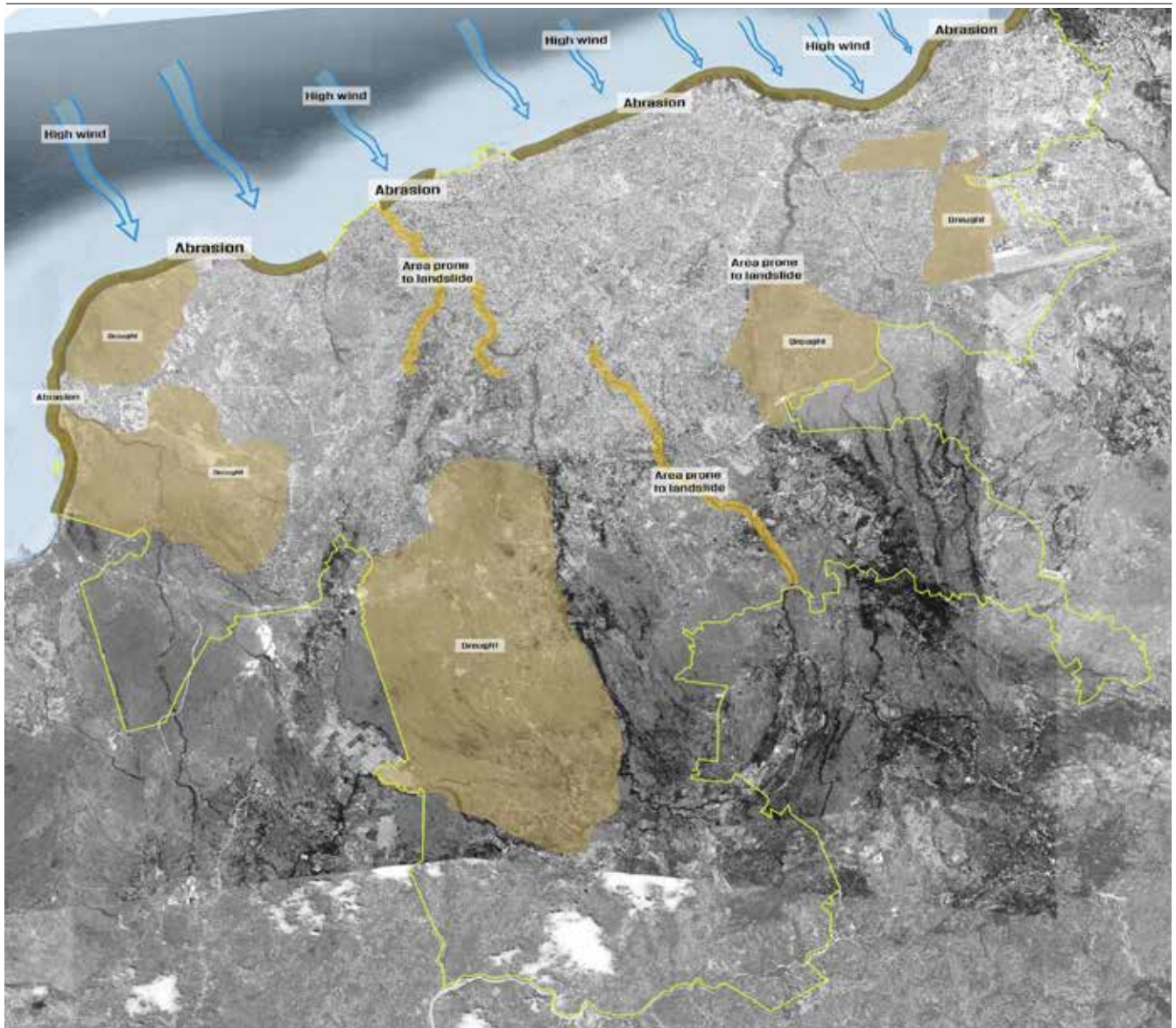


Figure 12: Along the coastline high winds threaten communities, while in outlying areas drought is a critical concern. A number of landslides have occurred along steep ravines that run along rivers which are dangerous during times of rain.

h. Infrastructure and Urban Systems

There are different scales of infrastructure, small-scale and large-scale infrastructure. Small-scale affects households or a particular community, while large-scale affects the whole city. Critical infrastructure and systems refers to those infrastructure of urban systems that are needed to support essential functions for the whole city. They include: the port, the airport, roads, trash collection, sanitation, water supply, and electricity. Here are some observations about the critical infrastructure of Kupang:

- **ROADS:**

THE ROAD SYSTEM IN KUPANG IS CONSOLIDATED IN THE CITY CENTER AND ALONG THE COAST, WHERE THE NATIONAL ROAD SUPPORTS CIRCULATION. HOWEVER, PERI-URBAN AREAS DON'T HAVE GOOD ROADS, MAKING SERVICE DELIVERY FOR WATER AND OTHER GOODS MORE EXPENSIVE AND VULNERABLE TO DISRUPTION. DURING TIMES OF DROUGHT THIS IS PARTICULARLY PROBLEMATIC.

- **WATER SUPPLY:**

WATER IS ONE OF THE PRINCIPLE ISSUES OF THE CITY, AND AS DEMAND INCREASES THIS WILL BE EXACERBATED. THE SUCCESSFUL CAPTURE AND DELIVERY OF WATER IS PROBLEMATIC, ESPECIALLY IN NEWLY DEVELOPED AREAS AND TO THE SOUTH (THE HILLSIDE AND MORE REMOTE AREAS OF THE CITY).

HOUSEHOLD DRINKING WATER ACCESSED FROM: PIPED WATER PDAM (38%), PRIVATE WATER TANK RE-CHARGE (27%), PRIVATE BORE WELL (24%), BOTTLED WATER (5%), AND PROTECTED WELL (1%).

- **IRRIGATION SYSTEMS:**

THERE IS NOT AN IRRIGATION SYSTEM FOR FARMERS, SO FARMING IS CHALLENGING ESPECIALLY IN DRY SEASONS (ALAK, FATUKOA, NAIONI, KOLHUA, NAIMATA, LASIANA, MANULAI).

- **COASTAL DEFENSES:**

MAN-MADE BARRIERS, SUCH AS SEA WALLS, AND NATURAL BARRIERS, SUCH AS MANGROVE FORESTS, RUN SPORADICALLY ALONG THE COAST. RECENT SEA WALLS ARE BETTER THAN COMMUNITY-MADE ONES, WHICH ARE OF POOR ENGINEERING QUALITY AND EASILY DESTROYED. MANGROVES ARE THE BEST COASTAL DEFENSE BUT ARE SCARCE AND NEED TO BE BETTER MAINTAINED.

- **PORT, AIRPORT:**

SINCE THE ECONOMY OF THE CITY DEPENDS SO GREATLY UPON THE IMPORT AND EXPORT OF PRODUCTS THE CITY'S PASSENGER AND FREIGHT PORTS, AIRPORTS ARE VERY IMPORTANT.

i. Urban Trends

Cities are constantly changing and evolving, sometimes very quickly, so what is happening today may change and be different tomorrow. The previous information gives us a snapshot of what is happening in the city today, but to prepare for development challenges ahead, it is important to have an idea about what the city will be like tomorrow. By observing the city, analyzing and discussing data, and relating them to different cities in the world, one can consider emerging trends and how their future impact on the city.

It is important to think about these trends because decisions taken now can help to either encourage positive change, or prevent negative change later. When we talk about vulnerability and climate change this is very important. Here are some urban trends in Kupang today that will continue in the near future:

- **CONTINUED GROWTH OF THE POPULATION AND ECONOMY**

IT IS LIKELY THAT THE POPULATION AND THE ECONOMY OF THE CITY WILL CONTINUE TO GROW. AS MORE PEOPLE COME TO THE CITY, THEY WILL FIND HOUSING IN PERI-URBAN PLACES LIKE ALAK, PENKASE, MANULAI II, BATUPLAT, AND BELO, WHERE LAND IS AVAILABLE AT LOW COSTS. THESE PERIPHERAL (PERI-URBAN) PLACES WILL KEEP EXPANDING. BUT IT WILL BE DIFFICULT FOR SERVICES LIKE WATER AND SCHOOLS, ELECTRICITY AND ROADS, TO REACH THESE PLACES. IN THE FUTURE THERE MAY BE SHORTAGES OF WATER AND JOBS FOR MANY NEWCOMERS. IN THE CITY CENTER NEW BUILDING AND BUSINESS WILL CONTINUE TO OPEN, BUT THEY WILL ATTRACT MORE TRAFFIC AND CONGESTION, AS PEOPLE LIVING FAR AWAY COME TO THE CENTER FOR WORK.

- **INCREASING DEVELOPMENT ALONG THE COASTLINE**

THE DEVELOPMENT OF HOTELS, RESTAURANTS AND RESIDENTIAL PROPERTIES WILL CONTINUE ON THE COASTLINE OF THE CITY, AND THE TOURISM SECTOR WILL GROW AS A RESULT. THIS MAY CAUSE THE DISPLACEMENT OF COASTAL COMMUNITIES, LIKE FISHERMEN, AND ALSO THE DESTRUCTION OF MANGROVE AREAS THAT ARE CURRENTLY ON THE COAST NEAR OESAPA. THE COASTAL AREA WILL BE MORE EXPOSED TO WAVES AND HIGH TIDES. HOTELS AND NEW LUXURY HOUSING DEVELOPMENTS WILL BE MORE EXCLUSIVE AND WILL CONTRAST WITH POORER COMMUNITIES, SO ECONOMIC GROWTH WILL BE UNEQUAL; SOME AREAS WILL BE VERY RICH AND SOME AREAS VERY POOR.

- **THE RISE OF INFORMALITY**

WITH MORE AND MORE PEOPLE CONTINUING TO ARRIVE IN THE CITY, BUT WITH A LIMITED AMOUNT OF JOBS AND PERHAPS SKILLS FOR THE JOBS THAT ARE NEEDED, THE INFORMAL ECONOMY WILL GROW. THERE WILL BE MORE TRADERS ON THE STREETS AND PEOPLE SEEKING EMPLOYMENT AND HOUSING WHEREVER THEY CAN. MANY PEOPLE WILL MOVE TO DANGEROUS AREAS, ALONG RAVINES AND ON EMPTY LOTS IN THE CITY, BECAUSE THEY ARE CLOSE TO MARKETS AND TRANSPORTATION. THERE WILL BE MORE AND MORE FARMERS ARRIVING IN THE CITY LOOKING FOR WORK TOO.

URBAN TRENDS IN KUPANG CITY

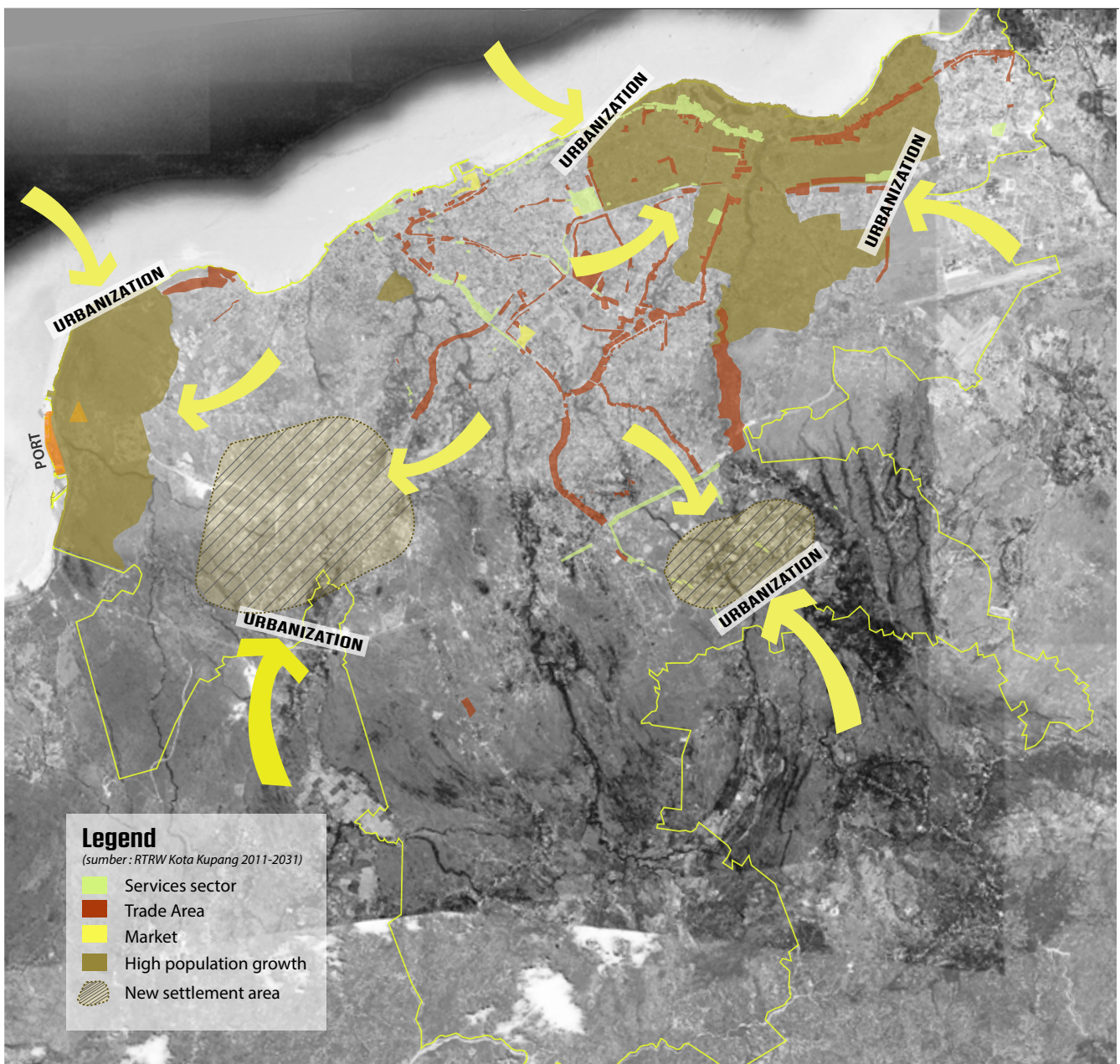


Figure 13: Certain parts of the city are urbanizing quickly, these are often on the periphery where land is available to be developed. There are also areas along the coastline where newcomers are arriving and finding housing opportunities.

j. Critical Issues going forward

Given that these trends towards increased urbanization and climate change will continue, we offer some planning considerations for the future. Reflecting upon critical issues can help us think about what the local government and stakeholders can do to respond to challenges. While it isn't necessary, nor possible, to have a response to these issues now, it is important to think about them. They will be very important when it comes to reducing vulnerability and increasing resilience in the following ways:

- **DEALING WITH DISPLACEMENT**

With the development of new hotels, offices, residential properties, and government buildings, many households may be displaced. Speculation will also fuel this and cause even more displacement as people seek profit at the expense of local communities. That means fishing villages and poor communities will be removed— but to where? It is important for government to develop adequate policies for the displacement of people, how they will be compensated, how they will find new jobs, transport, schools, access land titles and constitute new communities elsewhere. If this is not planned well then it will cause severe problems for the city in the future.

- **MANAGING GROWTH**

Continued arrivals of migrants can de-stabilize the city because it creates increasing demand for limited resources, like water, jobs, electricity, schools, and affordable housing. The government will have to think strategically how it can manage this growth. That means thinking about how to prevent people building houses and living in vulnerable areas, or encroaching upon natural areas like mangroves and protected forests. Also how to prevent conflicts at the community level, to ensure an adequate supply of water, and develop road infrastructure so people can get to their jobs. Managing growth also requires thinking about providing job training to ensure people have the skills they need to access

employment, so that the number of unemployed is reduced. Managing growth can bring great benefits to the city, but policies should be *proactive*, and not just *reactive*.

- **CREATING ECONOMIC DEVELOPMENT OPPORTUNITIES**

With the growing youth population and migration it is important to develop strategies and planning to create new economic development opportunities. These will be important to provide jobs for young people, and ensure that the city can continue to develop. Supporting economic development means building roads and infrastructure, and providing training and education. Also understanding how to work with the business community to support them, while not allowing business interests to override social interests. The large number of young people in the city can be a great asset and potential, but if they don't have the skills or ability to work, then it can be a big social problem.

- **PROTECTING THE MOST VULNERABLE**

Continued urbanization and climate change can create very challenging living conditions, where communities are exposed to physical risk (they live in steep areas prone to landslides or abrasion by big waves), or social and economic risk (they can't afford vaccinations or clean water, or are unable to pay for school, or people facing with social exclusion/discrimination like people with disabilities or women headed household). The government needs to understand what issues these people experience and where, and identify the critical areas that require social prioritization. Areas such as the expanding periphery, the poor communities along the coastline, the ravines, are where many poor people live at risk. Physical investments like re-planting mangrove forests and building protective sea-walls are some ways to protect them, but political and social investments, like policies, social campaigns, regulation enforcement, developing adequate social protection and better engagement with community leaders, are equally important ways of protecting the most vulnerable.

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Figure 14. Many newcomers to the city are unable to find adequate homes and squat on land that is not their own. They also have difficulty finding formal employment, so they often work in the informal sector, such as these ladies who make baskets from recycled material.

3. Exposure: What hazards is the city exposed to?

Indonesia's unique geography as an island chain makes it a beautiful place to live, but also particularly exposed to climate change hazards. In this chapter we look how climate change is affecting Indonesia generally, and trends which are more specific to the NTT region and Kupang City. By doing so we can gain a better understanding about how climate hazards affect people and communities in different ways, and how to respond to them accordingly.

a. Overview of climate change trend in Indonesia

Whether it is the prolonged effect of dry seasons, extra heavy rains, or fluctuating food prices due to affected harvests-- we are beginning to notice how climate change affects our daily lives. In the future, we can expect temperatures to increase 0.2°C each decade during the dry season, and 0.1°C each decade during

CLIMATE CHANGE INFORMATION FOR INDONESIA

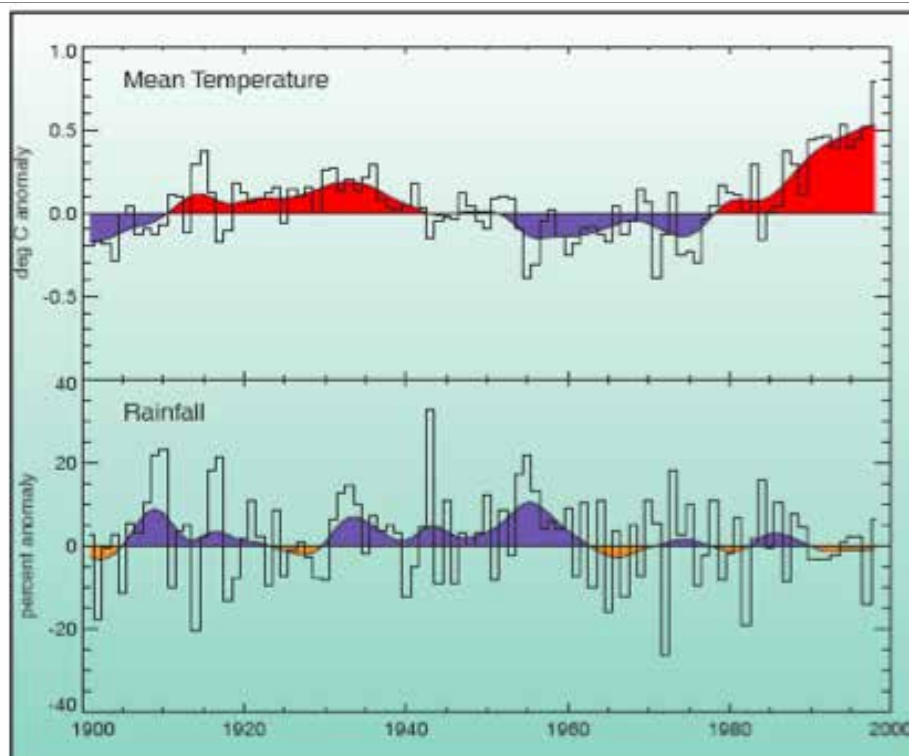


Figure 15. Mean temperature change from 1901-1998 above, and annual rainfall change below. Source: Case, Michael, Fitriani Ardiansyah, and Emily Spector. World Wildlife Fund International Climate Change Programme. "Climate Change in Indonesia Implications for Humans and Nature."

the rainy season (UK Met Office, 2011, pg. 12). Because Indonesia's temperature range is very narrow, even slight changes may alter ecosystems drastically. Understanding which climate change trends are most relevant at the national, regional, and local level, and how they impact vulnerable communities, can better inform short-term and long-term planning decisions.

Since the 1980s, the frequency of extreme weather events has increased. The top twenty worst natural disasters in Indonesia have all occurred in the past thirty years, and they will likely get worse (UNFCCC, 2010, xiv). In coastal regions, sea levels are estimated to rise by 25 to 50 cm in 2050. In the worst case, nearly 50% of areas near Semarang, Surabaya, and Jakarta will be underwater by 2100 (UNFCCC, 2010, xviii). While sea-level rise affects 600,000 people today, as many as 2.7 million people could be affected by 2070 (UK Met Office, 2011, pg. 3).

El-Nino, a warm ocean current which triggers strong winds, monsoons, and cyclones, has also had an extremely strong impact on drought in the Nusa Tenggara Province (NTT). Since the Asian Financial Crisis in the late 1990s, agriculture has continued to grow as an important sector of the economy. Prolonged drought during the dry season, and increased rainfall during the wet season, may significantly reduce rice and corn crop yields in some areas, while increasing them in other areas with more rain in Eastern Indonesia. Sea-level rise might also reduce shrimp, prawn, and fish yields for fisherman. Not only might these conditions threaten economy, and the livelihoods of farmers and fisherman, they also pose a threat to food supply (UNFCCC 2010, p. I-iii).

A final climate change trend to consider, which is especially felt at the local level, is the issue of water scarcity. Increased demand in growing mid-sized coastal cities, combined with prolonged droughts, may create water shortages (UNFCCC, 2010, xviii). Water basin capacity, or the natural ability of cities to store water, may also impact scarcity (UNFCCC, 2010, xviii). Some areas may have excess water supply while others, like West Nusa Tenggara, will not have enough. This could affect decisions at the local

level to allocate water resources. Often, the poor are disproportionately affected by water scarcity because they lack infrastructure, and must pay more to obtain water during a drought.

b. What is exposure to climate change?

Exposure as a term refers to:

"The degree of climate stress upon a particular unit of analysis (i.e. neighborhood, sector), and may be characterized by long-term change in climate conditions, or changes in climatic variability including the magnitude and frequency of extreme events in the urban context"

Our level of "vulnerability" to these risks is related to our exposure to climate hazards. Depending on the type of hazard, and in order to better understand the ways in which we are vulnerable, we will describe where, what, and how these hazards might affect us.

Climate Hazards: Sea-level rise: Rising global temperatures and melting ice caps are raising the sea-level slowly. This impacts the coastline and low-lying areas of our cities and rural areas.

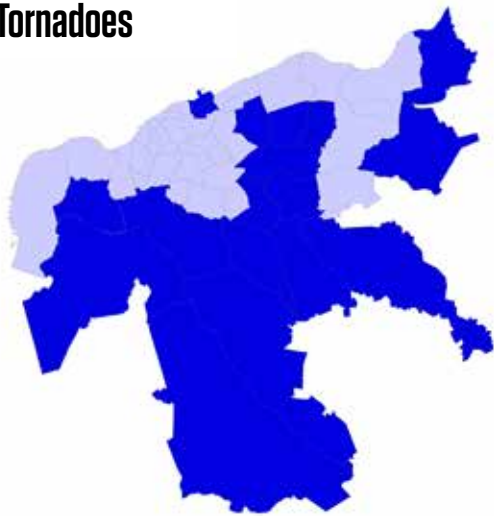
- **LOW-LYING COASTAL AREAS** - IDENTIFIED BY WORKSHOP PARTICIPANTS (SOURCE: BPBD)

SEA-LEVEL RISE AFFECTS THOSE LOW-LYING AREAS ALONG THE COAST WHICH FLOOD DURING HIGH-TIDE AND SEVERE STORM SURGES (WAVES), OR WHEN THERE ARE HEAVY WINDS THAT CAUSE ABRASION.

THE SCORING IS BASED ON THE NUMBER OF CASES OF FLOODING AND TIDAL FLOODS USING BPBD DATA, AT THE NEIGHBORHOODS (KELURAHAN) LEVEL. THOSE NEIGHBORHOOD WITHOUT FLOODING (0), THOSE LOCATED IN COASTAL AREAS BUT WITH NO CASES (1), THOSE AREAS LOCATED IN COASTAL AREA WITH 1-10 CASES (2), THOSE LOCATED IN COASTAL AREA WITH MORE THAN 10 CASES (3).

Climate Hazards: Increased temperature: Pollution comes from many sources, and is both producing and trapping harmful greenhouse gases in the atmosphere. These gases trap heat and increase temperature. Increased temperatures are already affecting short-term weather patterns, and likely to

Tornadoes



Strong winds



Sea-level rise & abrasion



Drought



Figure 16. Areas of the city exposed to the four principal climate hazards that most affect the city: tornadoes, strong winds, drought, abrasion and sea-level rise.

result in prolonged dry seasons and droughts.

- **EXISTENCE OF CASES OF DROUGHT** - IDENTIFIED BY WORKSHOP PARTICIPANTS (SOURCE: BPBD)

INCREASED TEMPERATURE IS LIKELY TO AFFECT THE WHOLE CITY, BUT WHEN THERE IS A DROUGHT THIS WILL PARTICULARLY AFFECT FARMERS AND THOSE WHOSE LIVELIHOOD DEPEND UPON AGRICULTURE, AS WELL AS THOSE WITH LITTLE ACCESS TO WATER. WE GAVE A SCORE (1) FOR INCREASED TEMPERATURE, AND SCORE (3) FOR KELURAHAN WITH CASES OF DROUGHT (SOURCE: BPBD).

Climate Hazards: High winds: One of the results of increased temperatures is stronger winds. At sea this

might mean bigger waves and storms, which affects fishing, and on land this might mean tornadoes and abrasion.

- **EXISTENCE OF CASES** - IDENTIFIED BY WORKSHOP PARTICIPANTS (SOURCE: BPBD)

HIGH WINDS ARE LIKELY TO AFFECT COASTAL COMMUNITIES, BUT ALSO THOSE WHO LIVE ON HILLSIDES EXPOSED TO WINDS, LIKE FARMERS. WE USED THE NUMBER OF CASES OF TORNADOES AND COASTAL WINDS IN A YEAR TO CALCULATE THE EXPOSURE RATE, IN WHICH (0) STANDS FOR NO CASES, (1) FOR 1-2 CASES, (2) FOR 3-9 CASES, AND (3) FOR MORE THAN 9 CASES IN A YEAR.

Climate Hazards: Unpredictable seasons and heavy rainfall: Another consequence of climate change is unpredictable seasons, which primarily impacts farmers, fishermen, and markets. Shorter, more intense rainy seasons also increase flooding.

- **AREAS WITH RAVINES, AND AGRICULTURAL AREAS**
(SOURCE: WORKSHOP PARTICIPANTS)

UNPREDICTABLE SEASONS AND HEAVY RAINFALL WILL AFFECT THOSE WITH STEEP AREAS AND RIVERS, AND AREAS EXPOSED TO DROUGHTS. TO CALCULATE THE EXPOSURE RATE, WE USED THE NUMBER OF CASES OF LANDSLIDES WHERE (0) STANDS FOR NO CASES, (1) FOR KELURAHANS WITH 1-2 CASES OF LANDSLIDES, (2) FOR KELURAHANS WITH 3-9 CASES, AND (3) FOR KELURAHAN WITH MORE THAN 9 CASES OF LANDSLIDES IN A YEAR.

c. Exposure across the city

Now that we’ve discussed the types of hazards we are exposed to, we can visualize how these hazards impact the city as a whole. To do this, we will consolidate these six indicators into one metric, which we call “exposure.” We created this measure by creating a points system which adds the different kinds of climate hazard that occur in each neighborhood. Through this mechanism, we are able to show which neighborhoods area exposed to many different climate hazards.

CUMULATIVE EXPOSURE MAP

4 Climate Hazards in Kupang:

- Sea-level rise and abrasion
- Increased temperature - drought
- High winds
- Unpredictable season and heavy rainfall

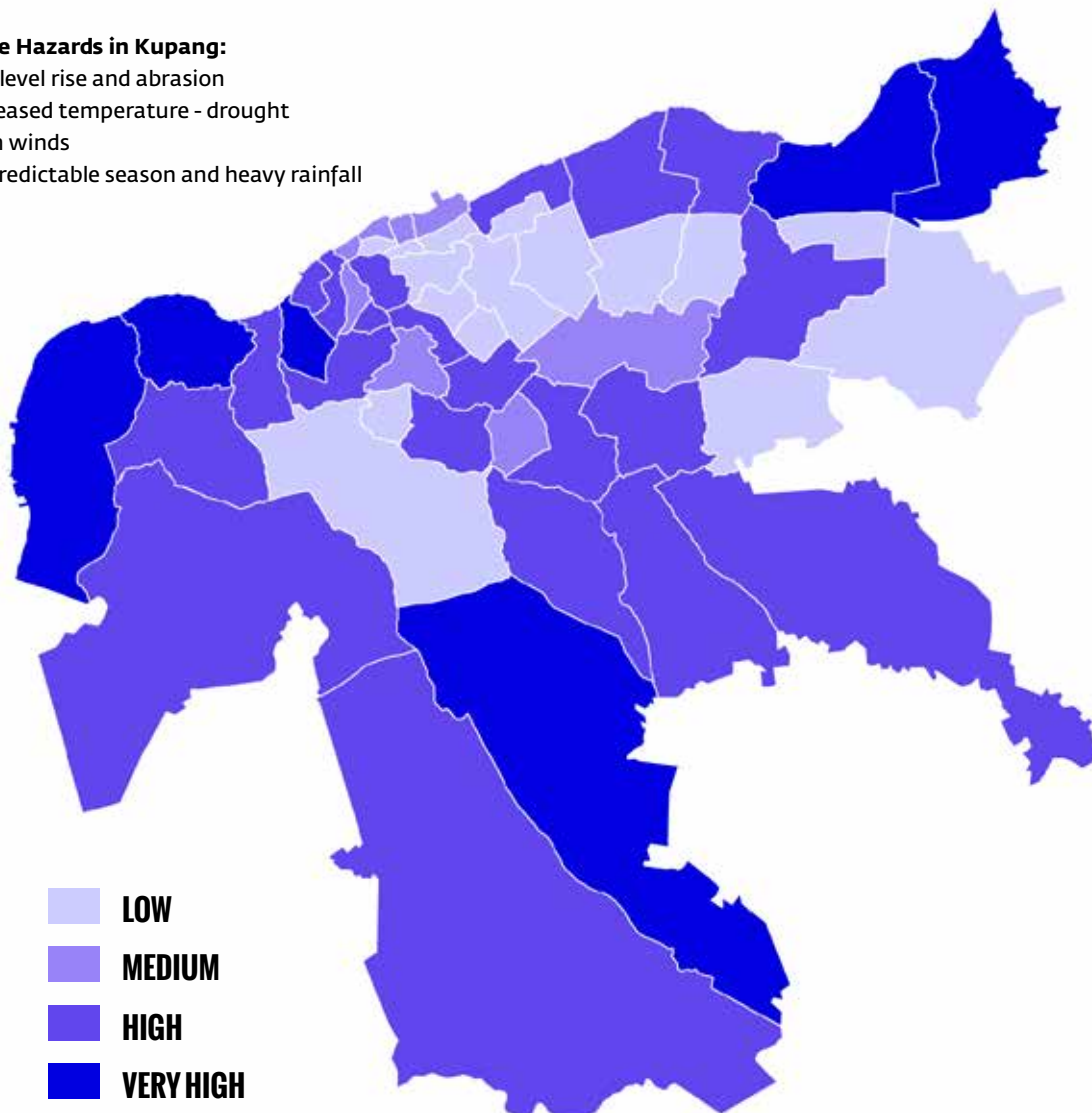


Figure 17. A consolidated map of exposure to climate hazards. Kupang is exposed to sea-level rise, increased temperatures, high winds and unpredictable seasons. But these affect the city in different places

d. How do climate hazards impact the city?

Climate hazards have a direct (primary) impact, as well as indirect (secondary) impacts. In general, primary impacts are physical, such as damage to ecosystems or to property and infrastructure. Because of these impacts they can lead to secondary impacts, where livelihood, health, and safety are affected.

The way that these hazards impact the city depends largely on the socio-economic context of the household or community, but also on what are called non-climate stressors, or things like the economy, ecosystems, the development of the city, and access to basic services. These will influence the degree to which places, people, or systems, are susceptible, or sensitive to climate hazards.

CLIMATE HAZARDS AND PRIMARY AND SECONDARY IMPACTS

CLIMATE CHANGE HAZARD	BIO-PHYSICAL EFFECTS	PRIMARY IMPACTS	SECONDARY IMPACTS
Sea-level rise	Flooding of coastal areas	<ul style="list-style-type: none"> • Destruction of coastal ecosystem such as mangroves • Abrasion and loss of coastal land • Damage to physical infrastructure and property of coastal communities • Poverty 	<ul style="list-style-type: none"> • Economic disruption to settlements, port, tourism activities • Disruption to road system leading to economic losses.
High winds	Damage to buildings and coastal infrastructure	<ul style="list-style-type: none"> • Damage to businesses and households leading to economic losses • Coastal communities lose homes. • Displacement of communities. • Decreased catch for fishermen 	<ul style="list-style-type: none"> • Impact upon fishing industry and local markets • Increase in cost of living
Unpredictable rains/drought	<ul style="list-style-type: none"> • Flooding of wells and septic tanks • Stagnant water no drainage • Contamination of water • Damage to crops 	<ul style="list-style-type: none"> • Illness from water and mosquito-borne disease • Damage to property and infrastructure • Heat strokes to elderly • Damage to crops • Decrease in local food supply • Decline in availability of water 	<ul style="list-style-type: none"> • Decline in yield of crops • Decline in local food supply and impact upon the poor • Decline of availability of water, increasing prices. • Economic disruption • Migration of newcomers from rural areas.

Figure 18. The table indicates the different kinds of impacts that each climate hazard can cause. Physical damages can lead to economic and public health impacts that negatively affect communities.



Figure 19. Households living along ravines, as in the case of those in Bello, are exposed to the risk of landslides during the rainy season, usually in January and February. As more and more people move to these areas they often cut down trees and vegetation promoting erosion. Falling rocks and material can cause damage to homes and injury people -- making these vulnerable areas.

4 Sensitivity: What makes the city vulnerable?

The impact upon communities of the above climate hazards varies dramatically, not only depending on where you live, but also on what you do, your education level, employment, and access to basic services. Another factor that influences sensitivity is urbanization — the city is also constantly changing, and these changes are making some areas more exposed to climate hazards than others. We must challenge ourselves to think about how the impacts of climate change will be felt differently by different communities, and to better identify what these different factors might be.

a. What is sensitivity?

There are a number of factors that can make the impact of climate hazards greater. While two people may experience the same hazards (rain/ heat/ wind), their capacity to withstand it, or survive it, is likely to be different. They may live in different houses, have different health conditions, different education levels, or different jobs, and consequently, different incomes. Given these factors, if two adjacent households both suffered from flooding, their capacity to recover would be different. One might have a house made of mud and wood that was destroyed, while another might be made of cement. One of the families might have wealthy relatives who could give them shelter, while the other may not have anyone else to help them.

These factors that differ affect the sensitivity of a people, communities or systems to climate change. Sensitivity means:

The degree to which different systems and sectors of the population are affected by climate related hazard.

b. Indicators to assess sensitivity

During the City Context workshop the participants identified a number of indicators that can be used to evaluate sensitivity in Kupang. Each indicator is explained below, and their source referenced.

- **POVERTY:** POVERTY LEVELS CAN DETERMINE THE AMOUNT OF ASSETS OR FINANCIAL RESERVES THAT A HOUSEHOLD MAY HAVE TO REPAIR DAMAGES FROM CLIMATE HAZARDS, ADJUST TO CHANGING CONDITIONS OR REBOUND FROM A DISASTER. [BPS]

TO MEASURE SENSITIVITY, WE CLASSIFIED THE PERCENTAGE OF POOR PEOPLE INTO THREE CATEGORIES, (1) – FOR KELURAHAN WHERE THE PERCENTAGE OF POOR PEOPLE WAS LESS THAN 27% (THE CITY AVERAGE), (2) IF 27% TO 49% OF THE KELURAHAN IS POOR, AND (3) – IF 49% TO 71% OF THE KELURAHAN IS POOR.

- **SETTLEMENTS IN COASTAL AREAS:** WHEN SETTLEMENTS ARE LOCATED IN LOW-LYING COASTAL AREAS THEY ARE MORE PRONE TO INUNDATION AND DAMAGE BY CAUSED BY WAVES AND SEA-LEVEL RISE. [WORKSHOP]

USING SETTLEMENT MAPS FROM BPBD, SCORE (0) WERE GIVEN TO KELURAHANS WHICH WERE NOT LOCATED IN COASTAL AREAS, (1) FOR KELURAHANS LOCATED IN COASTAL AREA BUT THERE IS NO SETTLEMENT, AND (2) FOR KELURAHANS LOCATED IN COASTAL AREAS AND THERE IS SETTLEMENT ALONG THE COAST.

- **RECEIVE MIGRANTS:** SETTLEMENTS THAT RECEIVE MANY MIGRANTS ARE MORE LIKELY TO EXPERIENCE OVERCROWDING, LACK BASIC SERVICES, AND MAY BE MADE OF LESS ROBUST MATERIALS, AS MANY MIGRANTS WHO COME TO THE CITY ARE POOR AND SEEKING OPPORTUNITIES. [WORKSHOP]

FOR THE SCORING, WE USED THE PERCENTAGE OF MIGRANTS OF EACH KELURAHAN, (1) IF LESS THAN 5.8% OF THE KELURAHAN HAS MIGRANTS, (2) IF MIGRANTS MAKE UP 5.8% TO 22.5% MIGRANTS, AND (3) IF MIGRANTS MAKE UP 22.5% TO 39% OF THE POPULATION.

- **EDUCATION:** EDUCATIONAL ACHIEVEMENT CAN DETERMINE THE ABILITY TO UNDERSTAND AND REACT TO INFORMATION WHICH CAN INCREASE RESILIENCE AND ADAPTIVE CAPACITY. [BPS]

WE USED THE INDICATORS OF 'PERCENTAGE OF ILLITERATE PEOPLE' (DATA BY BPS), WE SCORED (1) IF THEY HAVE PERCENTAGE OF ILLITERATE PEOPLE LESS THAN 3.6%, (2) IF THEY HAVE PERCENTAGE OF ILLITERATE PEOPLE FORM 3.6% - 7%, AND (3) IF IT IS BETWEEN 7% - 11%.

c. Mapping Sensitivity across the city

In order to look at *sensitivity* as a whole we will condense these indicators in a map. Just as we did before, we add their values together to create a composite. Thus if a neighborhood has higher than average levels of poverty and also poor education, its sensitivity value is higher than for those with higher than average poverty alone. Through this mechanism, we are able to show which neighborhoods are most sensitive to climate hazards.

From the consolidated map, demonstrating the 4 different indicators together, we see that the neighborhoods situated along the coast, and in the rural periphery are most sensitive to climate hazards.

CUMULATIVE SENSITIVITY MAP

4 Sensitivity Indicators:

- Poverty
- Receive migrants
- Settlements in coastal area
- Education level

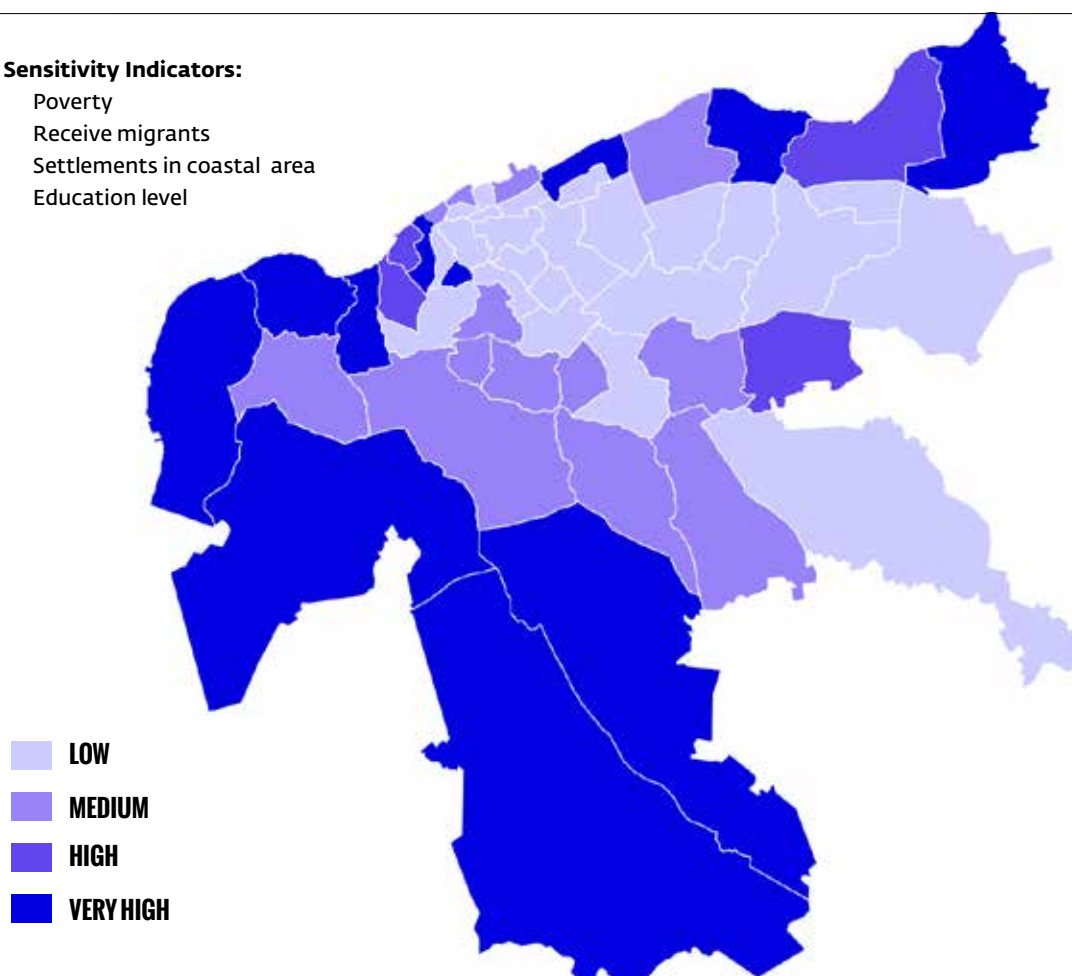


Figure 20. Sensitivity to climate hazards varies across the city due to differing levels of poverty rates, predominance of migrant communities and location along the coastline* Access to water will be added to this map

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Figure 21. An example of a good practice to reduce vulnerability in areas which are prone to landslides. The construction of retaining walls made of gabions prevents landslides, and protects people, their homes, and property during the rainy season.

5. Adaptive Capacity: What makes the city resilient?

City governments are not powerless in the face of climate change. There are measures that they can adopt, such as better planning, implement new policies, or enforcement and coordination mechanisms which can help to reduce vulnerability. Identifying what mechanisms are most effective in helping cities adapt to climate change, can contribute greatly to reducing their vulnerability.

In this chapter we will introduce the term adaptive capacity, and understand what policies and programs exist that support ‘institutional adaptive capacity’, and discuss how this may be increased in the city.

a. What is adaptive capacity?

The term *adaptive capacity* refers to:

The ability of a system to adjust to climate change so as to moderate potential damage, take advantage of opportunities, or help cope with consequences.

- **AUTONOMOUS**

AUTONOMOUS ADAPTIVE CAPACITY REFERS TO ACTIONS TAKEN AT THE INDIVIDUAL OR THE HOUSEHOLD LEVEL TO PROTECT LIVELIHOODS AND ASSETS FROM CLIMATE HAZARDS. THESE ARE USUALLY SMALL-SCALE AND EFFECTIVE FOR LOW INTENSITY DISASTERS. EXAMPLES MIGHT BE ADAPTING ONE’S HOUSE TO PREVENT FLOOD WATERS FROM ENTERING, OR KEEPING BELONGINGS STORED SO THEY ARE EASY TO RETRIEVE IN THE EVENT OF AN EMERGENCY.

- **COLLECTIVE**

COLLECTIVE ADAPTIVE CAPACITY REFERS TO ACTIONS TAKEN BY GROUPS, WHICH ARE USUALLY COMMUNITY INITIATIVES WHICH REDUCE VULNERABILITY. COLLECTIVE ADAPTIVE CAPACITY REQUIRES MORE PEOPLE, COORDINATION AND RESOURCES, BUT IS STILL LIMITED IN ITS GEOGRAPHIC SCALE TO THE NEIGHBORHOOD OR COMMUNITY UNIT. EXAMPLES ARE A NEIGHBORHOOD WARNING SYSTEM AND EVACUATION DRILLS, OR COMMUNITY-DRIVEN MANGROVE RESTORATION PROJECTS.

- **INSTITUTIONAL**

INSTITUTIONAL ADAPTIVE CAPACITY REFERS TO THE CAPACITY OF ORGANIZATIONAL SYSTEMS, SUCH AS GOVERNMENT PROGRAMS, POLICIES, REGULATIONS, AND HUMAN RESOURCES. THE SCALE OF INSTITUTIONAL ADAPTATION GENERALLY COVERS A LARGER AREA AND AIMS FOR SYSTEMIC AND LONG-LASTING SOLUTIONS.

EXAMPLES COULD BE: MAPPING OF DISASTER-PRONE AREAS BY BPBD, OR THE SYSTEMIC IMPROVEMENT OF WATER SUPPLY AND SOCIAL WELFARE PROGRAMS FOR POORER AREAS OF THE CITY.

We are most interested in discussing and developing ideas for institutional adaptive capacity mechanisms because these have the greatest potential to impact the most people, at the city scale.

b. Existing institutional adaptive capacity mechanisms

There are a number of ways in which governments can institute adaptive capacity to help build resilience. Most of these are policies, programs, and institutional measures, not brick and mortar infrastructure projects. Coordination amongst government agencies, enhanced transparency, and citizen

engagement, are examples of ways that governments can ensure better and more effective response to climate hazards or disasters. Some possible adaptive capacity mechanisms are: social welfare or safety net programs, safety regulations for hazardous areas, local infrastructure investment programs, neighborhood-level disaster preparedness committees, early warning mechanisms, and campaigns to raise awareness.

INSTITUTIONAL ADAPTIVE CAPACITY MECHANISMS

Possible Examples of Adaptive Capacity	
Social welfare or safety net programs	<ul style="list-style-type: none"> Active safety net programs are only national-level programs such as Raskin, Keluarga Harapan, and health insurance through BPJS.
Safety regulations for hazardous areas	<ul style="list-style-type: none"> There is a regulation for coastal settlements in which houses must not be located near retaining walls, and if there is no retaining wall then houses must be located over 25m from the high tide mark (DTRK). There are some regulations related to environmental standards and procedures for development, but often they are not enforced.
Local infrastructure investment programs	<ul style="list-style-type: none"> The Kupang city government has a "Green and Clean" program which attempts to intensify tree planting and improve trash management. This program requires more focus and support. (DKK) The government is currently building sea-walls along the entire coastline, and are planning to repair damaged, existing sea-walls.
Neighborhood-level disaster preparedness committees	<ul style="list-style-type: none"> There is no city-level forum or disaster preparedness committee. The youth scouts program Taruna Siaga Becnana (TAGANA) promotes volunteerism. Only BPBD addresses disaster issues at the city-level.
Early warning mechanisms	<ul style="list-style-type: none"> There are no early warning mechanisms in Kupang City. There is a plan to implement a tsunami evacuation routes.
Campaigns to raise awareness	<ul style="list-style-type: none"> Messages are sent by the Marine and Fisheries Department to fishermen about weather conditions. (DPK)

Figure 22. There are a number of ways that cities can promote adaptive capacity, these ideas can inspire policy change and community initiatives.

c. Mapping Adaptive Capacity across the city

From our previous workshop we collected a few indicators that can demonstrate levels of institutional adaptive capacity throughout the city:

- ACCESS TO ELECTRICITY:** NUMBER OF USERS CONNECTED TO PLN (PLN DATA).

TO MEASURE ADAPTIVE CAPACITY RATE, WE CATEGORIZED THE PERCENTAGE OF USERS CONNECTED TO THE ELECTRICITY SUPPLY (PLN) OF EACH KELURAHAN INTO 3 CLASSES, USING A SCORING OF 1, 2, OR 3. THE HIGHER SCORE MEANS THAT THE KELURAHAN HAS MORE PEOPLE CONNECTED TO PLN, INDICATING THAT THE GOVERNMENT HAS THE NETWORK TO REACH MORE PEOPLE.

- EXISTENCE OF 'KELOMPOK PENGELOLA SUMBER DAYA':** EXISTENCE OF KELOMPOK PENGELOLA SUMBER DAYA,

WHICH IS A KELURAHAN-LEVEL GROUP, MONITORED BY THE DEPARTMENT OF ENVIRONMENT, THEY HAVE THE CAPACITY TO REACH MORE PEOPLE IN TERMS OF RAISING AWARENESS AND COMMUNITY EMPOWERMENT (SOURCE: BLH). WE GAVE THE SCORE (0) FOR KELURAHAN WITH NO GROUPS PRESENT, AND (1) FOR KELURAHANS WHICH HAVE A GROUP.

- **NUMBER OF HEALTH FACILITIES:** AVERAGE RATIO OF HEALTH CENTERS OR PUSKESMAS (BPS DATA) TO NUMBER OF POPULATION, (1) FOR RATIO 1:2 (CITY AVERAGE), (2) FOR THOSE WITH A RATIO OF BETWEEN 1.2 TO 1:10.8, AND (3) FOR THOSE BETWEEN 1:10.8 TO 1:19.5.

Through mapping adaptive capacity across the city we are able to see that it varies considerably from neighborhood to neighborhood. It is generally higher in neighborhoods along the coast, especially in the far east and west of the city, but there are also several neighborhoods in the center, that have very low levels. It is important to remember that adaptive capacity can be increased by government intervention; improving networked services, social welfare and promoting community organizations, will all result in increasing adaptive capacity to climate hazards.

CUMULATIVE ADAPTIVE CAPACITY MAP

3 Adaptive Capacity Indicators:

- Access to Electricity
- Existence of 'Kelompok Pengelola Sumberdaya'
- Ratio of health facility to population

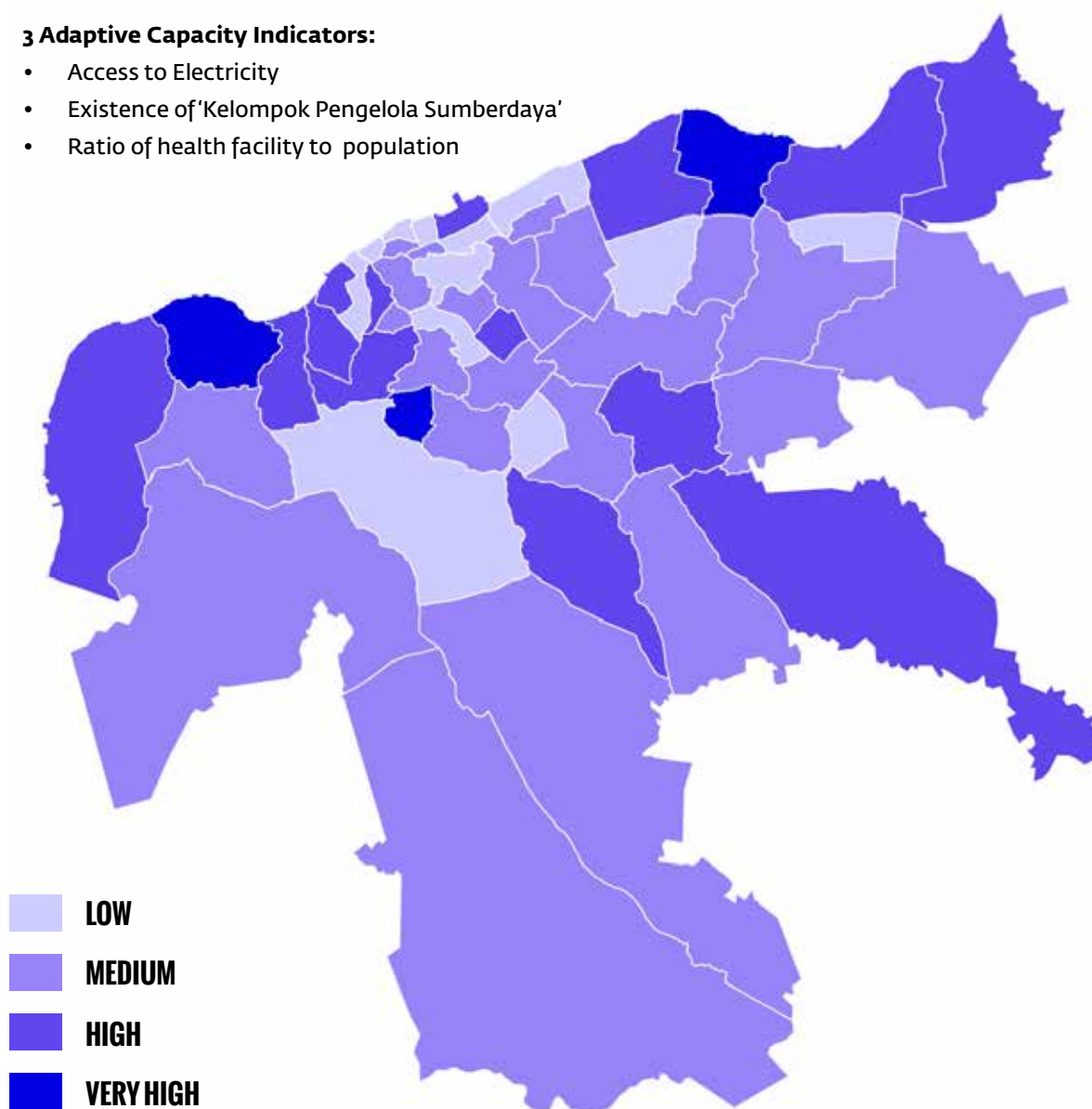


Figure 23: Consolidated map of Adaptive Capacity map across Kupang City demonstrates that adaptive capacity is spread unevenly throughout the city



Figure 24. The impact of abrasion of coastal areas is already present. Damaged sea-walls demonstrate how they have limited success in blocking the destructive power of the sea, so other solutions are necessary. Replanting mangroves is a possible solution that can be implemented with the help of coastal communities themselves.

6. Identifying Vulnerability in the City: a Qualitative and Quantitative Analysis

a. Different ways of identifying vulnerability

Vulnerability can be understood differently through a number of dimensions. We want to challenge you to think about it from a variety of perspectives, because this can help you to design better policies, better target the most vulnerable people, and better prioritize projects and interventions. So we are going to have you think and reflect upon vulnerability in terms of Where? Who? and What? systems are most critical. In order to balance this qualitative assessment we will also present a quantitative assessment to help us identify vulnerability in the city.

b. Vulnerable Places: An assessment of two neighborhoods

To identify how certain areas become vulnerable we looked at two different neighborhood typologies that are exposed to some of the most common hazards: drought, sea-level rise, heavy rains. The neighborhoods that were studied in more depth were selected by the City Context workshop participants, they used the following criteria:

- NEIGHBORHOODS EXPERIENCED CLIMATE HAZARDS ON A REGULAR BASIS
- NEIGHBORHOODS WERE PARTICULARLY SENSITIVE, THEY HAD HIGHER THAN AVERAGE POVERTY LEVELS, RECEIVED

MIGRANTS, AND WERE CHALLENGED IN ACCESSING BASIC SERVICES.

- NEIGHBORHOODS WERE REPRESENTATIVE OF OTHER AREAS IN THE CITY; ALLOWING LESSONS LEARNED FROM THEM TO BE APPLIED MORE GENERALLY.

The neighborhood assessment looked not only at *data* about neighborhoods, but actually visited and studied micro-regions or specific areas *within* neighborhoods, that are vulnerable to climate hazards. The unit of a neighborhood, or *kelurahan*, is actually too big to use since some places within them can be very dangerous, or concentrate poverty, while others can be very wealthy and safe.

Two neighborhoods were studied in detail; the survey team conducted interviews with residents and also a series of transect walks, to identify the nature of the vulnerability, and also the way that it had evolved. The two neighborhoods were: (i) Belo, an area on the periphery of the city where farmers are being displaced by housing development, and also an area prone to floods and mudslides. The other area (ii) was Oesapa, a coastal area where a mix of people live, traders, middle class settlers, Bugis fishermen, all using the coastline differently.

Kupang City is constantly transforming and these changes, to its housing, services, economy, geography and population, will all impact the levels of vulnerability of the population.

Oesapa

Oesapa is like many communities along the coastline. Originally there were mangroves that protected the coastline from waves and wind, serving as a natural barrier. Perhaps at this time there were small-scale farmers living there, but in the past the coastline was much less intensively used.

With the growth of the city, many people move to the coastline to benefit from the fishing industry. They can either be fishermen, those that sell fish like

traders, or those that buy fish. With this growth you find more houses, more shops, and communities have cut down some of the mangroves to open access to the sea. The coastal area evolves to be a hub of economic activity where different income groups are making use of the area.

Further urban growth results in even more intense usage of the coastline. Now we see that the mangroves have been cleared completely to make room for more

OESAPA FACTS

26,168

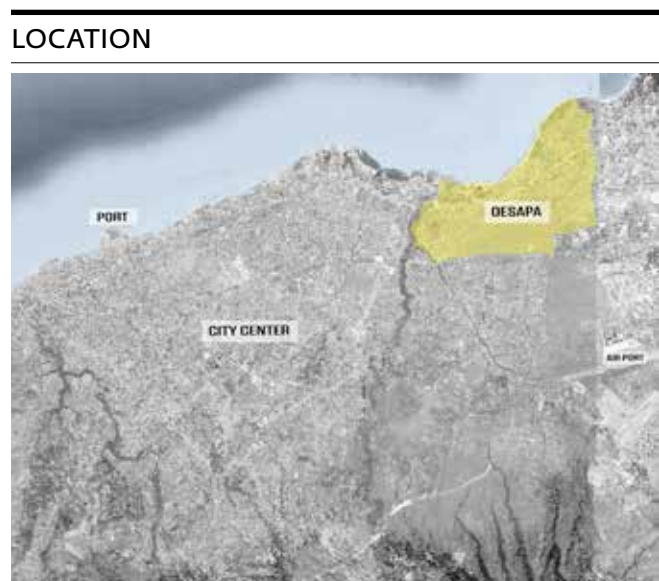
Population

9.99%

%HH in Poverty

GENERAL PROFILE

Total Land Area	: 437 ha
Location	: Northern part of Kupang
Geographic condition	: Low-lying coastal area
Population Density	: 60 people / ha
Poverty	: 9.99% (city average: 15.90%)
Trend	: Land tenure issue, coastal community, fishermen neighbourhood, displacement issue
Vulnerability	: Abrasion, High winds, Sea-level rise.



OESAPA VULNERABILITY



Figure 25: The local economy of fishing settlements in Oesapa depends upon the daily catch of fish. Fish that are caught at sea can be sold fresh, or dried, and then sold at the local market which is also located in the same neighborhood.

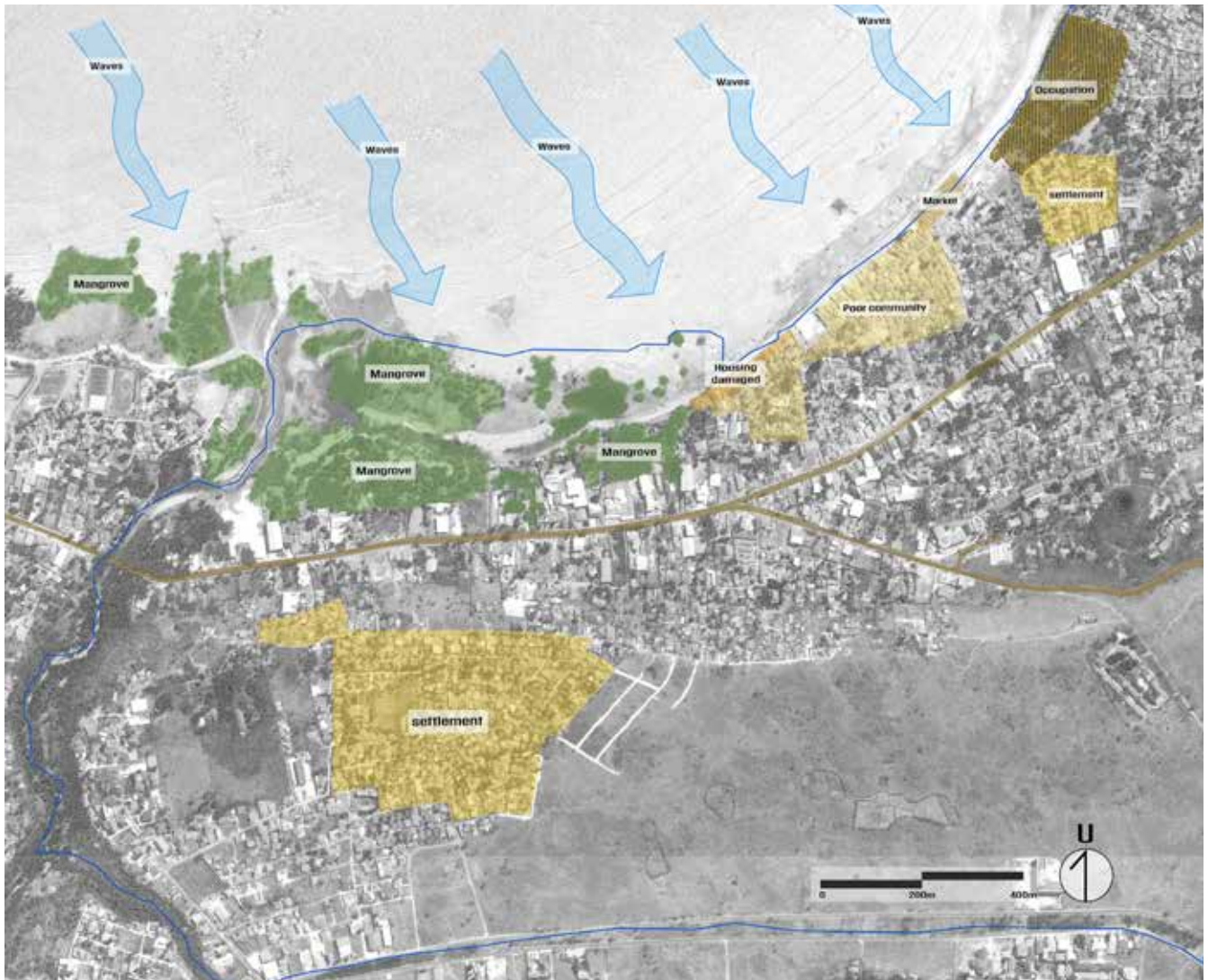


Figure 26. Poor communities along the coast are vulnerable to waves and high winds as mangroves have largely been destroyed along large sections of the coastline.

access to the sea, and the community has had to create its own barrier, a sea-wall. But an ad-hoc sea-wall is unable to defend the power of waves, and this has been destroyed, often with heavy damage to homes and buildings behind it. You also see more intense building along the coastline, with hotels and restaurants; these now block access to the coastline and have displaced many original residents.

From this sequence we see that the coastal areas along Oesapa have changed a lot over the last 20 years. We see too in the aerial photo that there are some places that have a different development story, for example the big lots of undeveloped land behind the road.

URBANIZATION PROCESS IN COASTAL COMMUNITIES - OESAPA

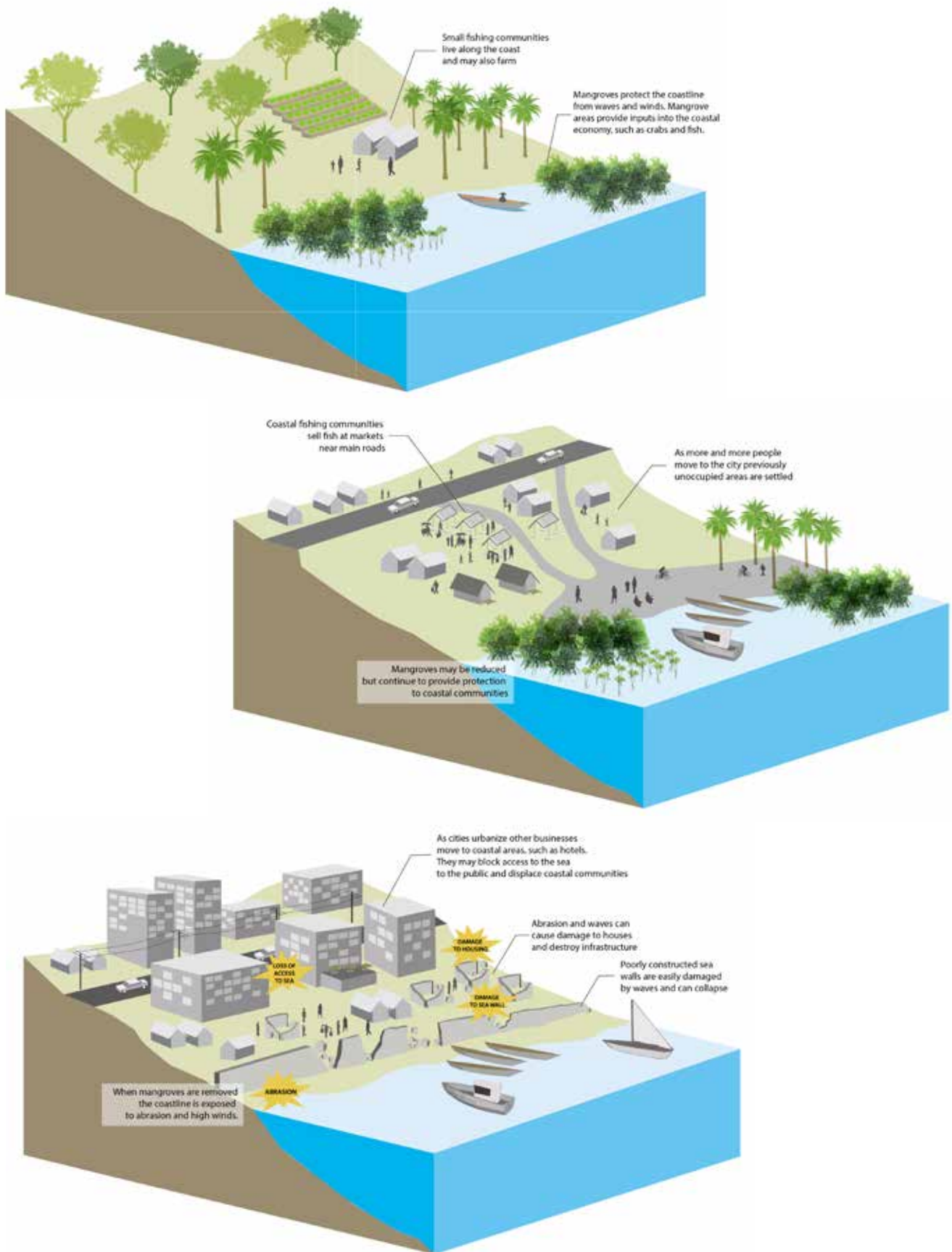


Figure 27: Sequence of urbanization along coastal areas of Kupang City demonstrating how increasing numbers of inhabitants contributes to higher vulnerability levels

Bello

Bello is located in the hilly area of the city on its rapidly growing periphery. As more people move to Kupang more people will be moving to places like this because there is still land available and it is relatively close to markets and connected by roads. What is interesting is that you have agricultural areas, and also ravines, both have different vulnerability issues.

Ravines are steep areas through which rivers flow. Many years ago these were uninhabited and were full of trees and vegetation, maybe a few farmers farmed the land, but very few people because they were far from other economic activity. As the city grew roads

and housing started to surround the ravines, people might have used the river to gain access to water. Poor people moved there because the land was not occupied, but it was close enough to jobs; people move to areas where the risks are worthwhile for the returns (in this case jobs, land and water).

As people move to the ravines they clear the trees and build homes by themselves. These are often not safe because they are on steep hillsides. They may also be places where trash is dumped. When trees are cut down the likeliness of landslides increases.

BELLO FACTS

<h2 style="margin: 0;">3,788</h2> <p style="margin: 0;">Population</p> <div style="width: 100%; height: 10px; background-color: black; margin-top: 5px;"></div>	<h2 style="margin: 0;">27.96%</h2> <p style="margin: 0;">%HH in Poverty</p> <div style="width: 100%; height: 10px; background-color: #ccc; margin-top: 5px; position: relative;"> <div style="width: 28%; background-color: black; position: absolute; left: 0;"></div> </div>
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GENERAL PROFILE

Total Land Area	: 575 ha
Location	: South-east part of Kupang
Geographic condition	: Ravines area in the border
Population Density	: 7 people / ha
Poverty	: 27.96% (city average: 15.90%)
Trend	: Migration from outside the city, development of new settlement area in the peri-urban.
Vulnerability	: Landslide, high winds.



BELLO VULNERABILITY -- RAVINES AREA



Figure 28. The steep sides of the ravines in Bello are quickly becoming inhabited as households look for available land and living opportunities in the area. There have already been numerous landslides here that have resulted in injury and death; this will only worsen with more heavy rain and the construction of precarious housing on steep slopes.

URBANIZATION PROCESS FOR SETTLEMENTS ALONG RAVINES -- BELLO

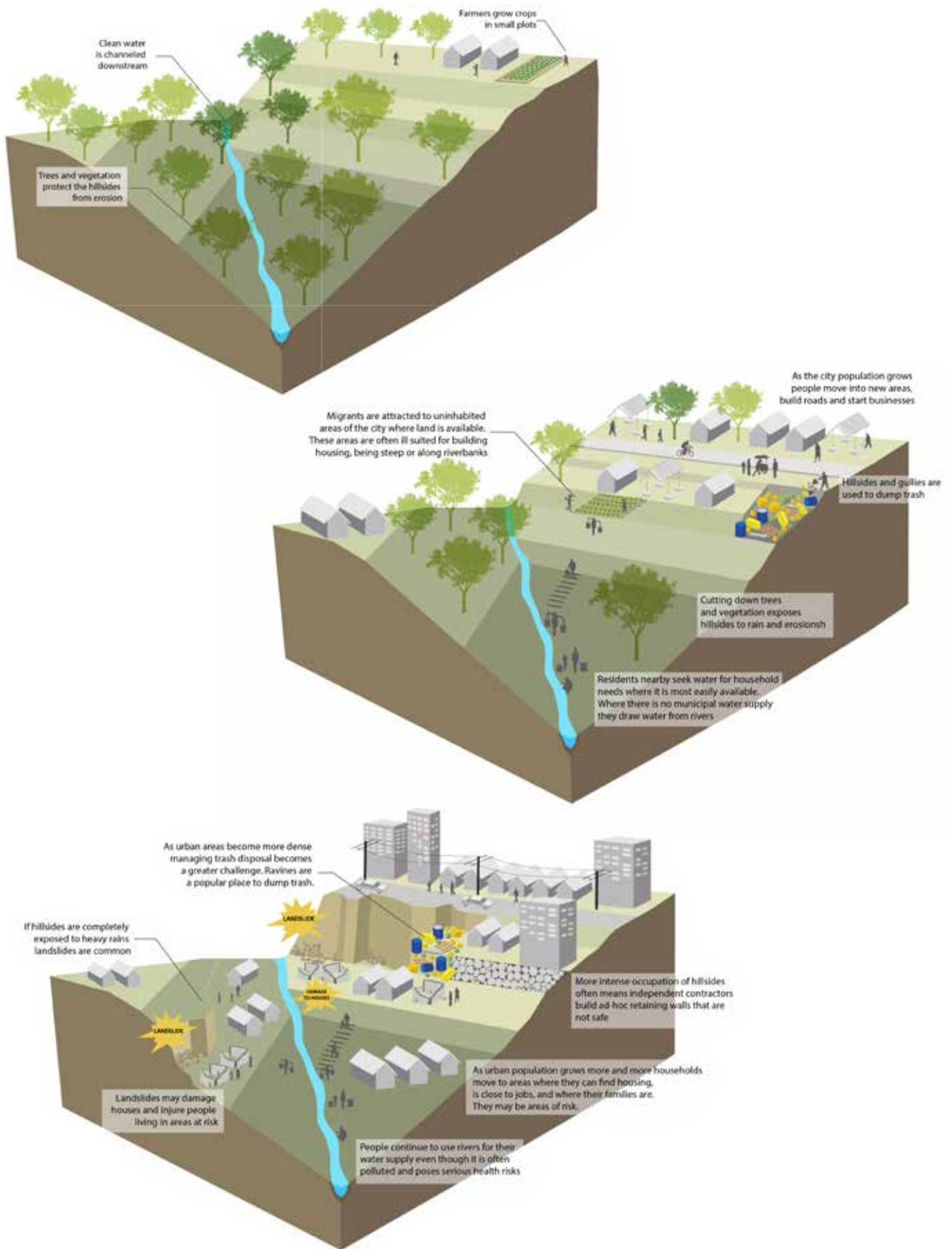


Figure 29. Sequence of urbanization process for settlements on steep hillsides demonstrating how increasing numbers contributes to increased vulnerability.⁶

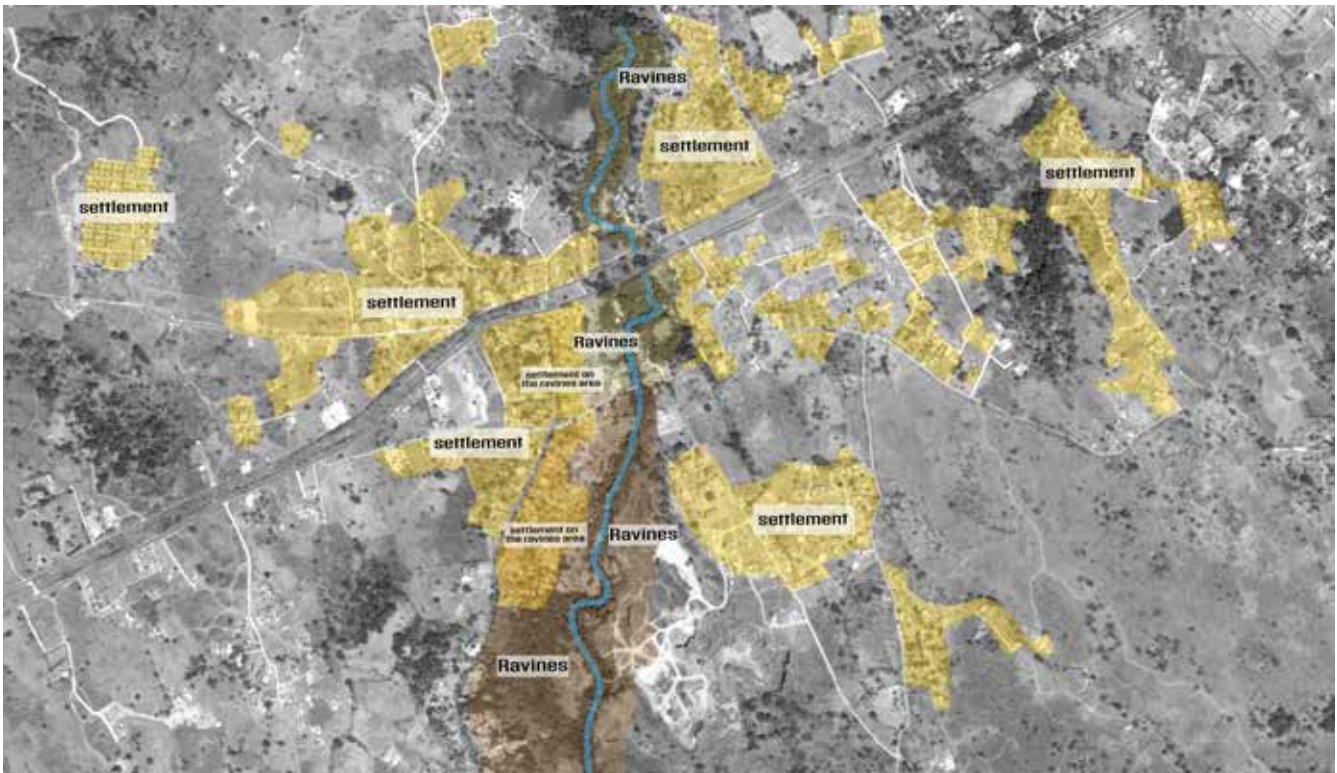


Figure 30. As settlements spread and encroach upon steep ravines vulnerability increases. Households building there cut down trees and vegetation, heavy rainfall then provokes erosion; these conditions lead to landslides and hazardous conditions.

With further urban growth and development these areas become more and more dangerous. We see here the area without any trees, people building large buildings, maybe boarding houses, or extensions to their shelters, but the retaining walls are of poor quality and at risk of being destroyed. When it rains the slopes are exposed and more likely to experience landslides, and with more people living there, these become increasingly deadly. Ravines turn into areas of extreme risk, where polluted water, landslides, trash and hazardous construction, can combine with heavy rains and a lack of tree and vegetation to cause major human risk.

There are also large parts of Belo that are undeveloped. They may be still farms or forested wild areas. In these areas droughts and high winds are a concern; they particularly affect more rural areas on the edges of the city, such as the hilly areas to the south.

The peri-urban areas of Belo about 20-30 years ago where largely unpopulated, covered with trees that help absorb rain and contribute to absorption of rain

into the river system. As people start moving to the city development pushes outward, areas like this may have farms and some housing. To make way for these activities trees are cut down, roads are built and people move there.

When the city really starts to grow development continues to expand the city outward. Land markets make the peri-urban area locations for big housing development projects or shopping areas. There is a lot of change to the natural systems, trees are cut down and often the rivers are straightened to prevent flooding. This may reduce protection from wind erosion, and cause additional sedimentation of rivers downstream, which contributes to flooding of the city.

From the two neighborhood studies we can better understand how urbanization is making some areas of cities increasingly vulnerable to climate hazards, and those that are worst affected are the urban poor who live in the most vulnerable areas.

URBANIZATION PROCESS FOR SETTLEMENTS IN PERI-URBAN AREA -- BELLO

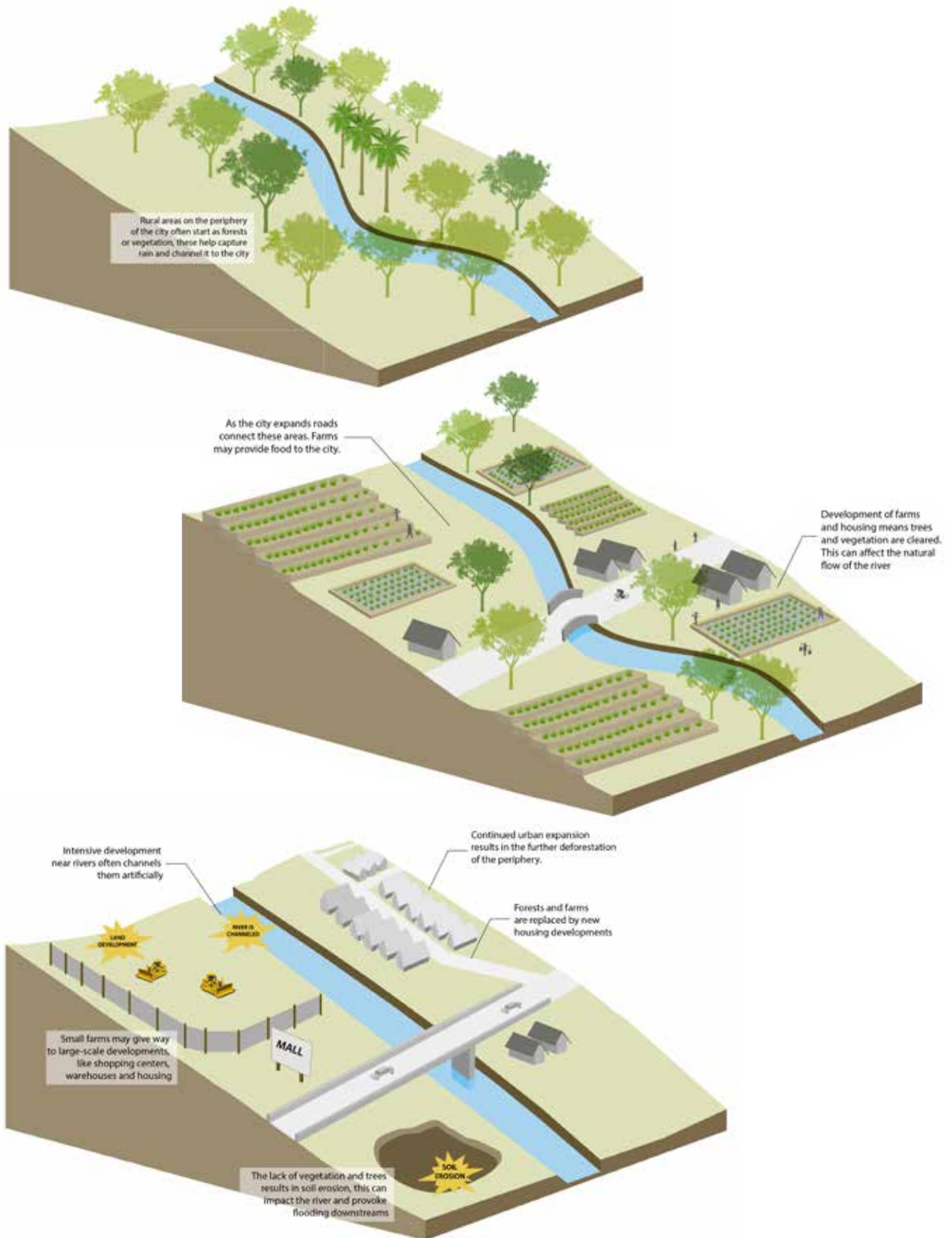


Figure 31. Sequence of urbanization for settlements in peri-urban areas, in Kupang City's periphery. The sequence demonstrates how expansion contributes to increasing vulnerability.

c. Vulnerable People: 4 accounts of vulnerability in Kupang

Another way to think about vulnerability is through the eyes of different groups of people. Climate events, such as extreme heat, or heavy rains, affect people differently depending upon their age, their physical condition, their jobs, their education and their access to services. Older people for example suffer much more than younger people from extreme heat. Very young children are vulnerable to flooding because they may not have a way to escape.

Throughout the city there are different kinds of people; they can all experience vulnerability in a variety of ways. We want to introduce four different people. They are not necessarily real people, but they are derived from real people that we met throughout the city, especially those living in areas of high exposure, high sensitivity, and that have already experienced some disasters. The narratives help give us an idea how climate change affects people, and the ways they struggle to reduce vulnerability. They provide context to our discussions and help us understand different perspectives of real people.

VULNERABLE PEOPLE

Heavy rainfall and landslides

Yosefina, 40 years



My name is Yosefina, I am 40 years old and moved to Kupang from Flores. I moved here to find a job and thought I'd have better chances here since my town in Flores is so small. I live in one of the steep ravine areas in Bello, together with my husband and two children. In the past we've experienced landslides during the rainy season, but we can't afford to move, and we like the area because we know the people and my job, as a vendor at the market, is close by. My husband works as a construction worker.

The most difficult time of year for us is during the rainy season because it rains everyday and it is so vulnerable to landslides. When it rains at night we have to stay awake to take care of the children. Rocks from other houses fall down, and can crash into our house. When it gets damaged we have to spend money to repair it and this is expensive for us; we earn so little money anyway.

I am really worried about the future of my children, I'm afraid that my children will be injured in an accident like this. And we also worry since every day the community grows a bit, there's more construction, and more people. This makes it more dangerous because the water from the rain is more powerful.

Abrasion

Maria, 38 years



My name is Maria, I am 38 and I moved from Rote to Kupang to an area which I occupied, it was not our land but it was cheap. About five years ago my husband passed away, now I am alone with my two children, I work in the fish market. In 2011 there were really strong winds that destroyed the market and my stall was destroyed, I lost my investment in my stall, I lost everything. My house also was damaged and flooded, it was so hard, I had to move away to the house of friends and spent all my savings to fix up the house and buy food for my children. Without my husband's salary it was really difficult. I am worried about our future because we don't have land tenure and I don't know what will happen if the owner comes back.

Heavy winds on the coast

Anshar, 45 years



My name is Pak Anshar. I am 45 year and work as a fisherman. I live in Oesapa Barat but moved from Sinjay 10 years ago with my family looking for a place where I could sell my fish. I started living on the coast and working in the fish economy, working with a small boat. I now live with my two sons in a small house near the beach. Last year my boat was trapped by a big wave and this broke my boat. I couldn't work for 4 months. Every year during the rainy season my house is often flooded and damaged, and it is difficult for us because we have to spend limited savings to make repairs. During the rainy season we also don't have access to clean water since our only source of water by the beach gets covered by sea-water. During this period we have to buy water from the private provider and this gets expensive.

We have a difficult situation too because we need more money to repair our house, for water, and so sometimes I have to borrow money from my boss. But he charges really high interest. We're worried if my boat is damaged or destroyed again. And with all the household costs we have for education. If we could have a jetty we could park the boats far away from the coastline and this would help protect our boats from the waves.

Increasing Temperature

Felix, 60 years



My name is Felix, and I am 60 years old. I live in a dry area at the top of the hillside on the border of the city. I am Timorese and I've been living here for many, many years— for as long back as I can remember. I am a traditional farmer. I cultivate vegetables. During the dry season the temperature really gets hot and this makes it difficult for me, as water becomes very scarce and there's no irrigation for us. Usually I take water from the river nearby for my plants but this is dried up during the dry season, so I can't do anything. I have to minimize the use of water, for example washing or bathing. The increasing temperature increases problems for my family because my children easily get sick, get dehydrated, have itchy skin problems, or ISPA caused by all the dust. Sometimes I have to take them to the health center, and this can be expensive for me.

d. Vulnerable Systems: 5 critical systems at risk

Vulnerability can also be thought of on a much larger scale, in terms of urban systems. Urban systems are networks of services that cover large areas of the city, or the entire city. They provide services for many citizens, like clean water delivery system or the drainage canal system. These systems can also be vulnerable to climate hazards.

If these systems are damaged or fail, problems can be widespread problems. This is why we call them critical for the city's population and functioning. For example, a problem with the water treatment or supply system can affect the supply to tens of thousands of people. Some of the critical systems identified for Kupang are:

the water supply system, the coastal defense system, and the road network.

Water Supply

Perhaps the most critical network for the city is the water supply network. This network is threatened by increasing demand for water from the city's growing population, and a difficulty to increase supply. Since it is rare that households can access water from their own private, their community's public, wells, they are forced to rely on the PDAM system or water vendors. Water can be expensive, so buying water from vendors is most exclusionary for the poor.

At the moment we found some communities, such as that in Nainoni, where people have very limited access to the water supply. They come to the river to fill up

tanks sometimes 5-6 times a day, and spend about 30-60 minutes to just collect 3-4 plastic bottles (each contain 5 litres water). Otherwise they receive water from vendors using delivery trucks which can cost 570,000 Rp a month.

Coastal Defense System

The coastal defense system protects the city from abrasion and flooding. This is not really a single man-made system, because in the past it was partly made up of mangroves. But as the more and more development moves to the coastline, and sea-level rise continues, some structures (man-made or natural) will be needed to protect the coastline.

Some communities have tried to build sea-walls, but these kinds of initiatives are not successful because a sea-wall requires engineering and lots of materials. In other areas the Public Works Department has constructed a sea-wall that is more robust. There are also efforts to restore mangroves.

The Road Network

The road system is the network of roads that connects

different parts of the city together and also connects the city to rural areas, to the airport, port, and the national highways. The road network is critical because so many things rely on it, for example medical services, evacuation from a disaster, even the delivery of water supply. If certain roads are damaged, or cut off, then they can cause other problems.

Another issue is the continuing expansion of the system, to meet increasing needs. As areas of Alak, for example, continue to grow, roads are required to service them. Roads need to be maintained regularly.

The Drainage System

Kupang's drainage system is very disjointed, such that many workshop participants didn't believe it was a system at all. One of the reasons for the fragmented nature of drainage is the topography of the city, and the interrupted way in which the city has developed over time. One of the issues of a disjointed system is that water from heavy rains doesn't drain adequately, leading to standing water. Another issue is that drainage ditches become filled up with trash and are blocked. The lack of adequate trash collection impacts drainage creates other negative impacts.

VULNERABLE SYSTEM



Figure 32. Kupang's critical urban systems include the coastal defense system, currently made up of a combination of sea-walls, beaches and mangroves; and also the water supply system. Both systems have gaps. The coastal defenses need better management, such as mangrove replanting programs; while the water supply network does not yet extend to the periphery, and service is irregular in many urban neighborhoods.

The City Port

The Port of Kupang City is an incredibly important part of the city's supply system, providing access to food, vegetables, cement and fuel. In the past when the sea became too rough for navigation the port became inaccessible, as a result the price of cement rose significantly. The consequences of the price rise constrained development and the local economy.

e. Mapping vulnerability in the city: a Quantitative Approach

Having reflected upon the different ways of thinking about vulnerability we can also use the indicators to show us where vulnerability is concentrated. This we are calling our *quantitative* approach. We are using the unit of the neighborhood, so this is not a very precise

measure in terms of specific locations, but it does help in terms of understanding how vulnerability can be distributed across the basic administrative unit, the *kelurahan*. This unit may be helpful in indicating ways for vulnerability to be reduced through the city's planning and policymaking mechanisms, which act through this administrative unit.

We use the standard definition used by the Ministry of the Environment and the UN, which states:

$$\text{Vulnerability} = \frac{[\text{Exposure} \times \text{Sensitivity}]}{\text{Adaptive Capacity}}$$

By taking the indicators that were selected previously and organizing them into a data sheet and calculate the overall vulnerability of each neighborhood.

CUMULATIVE MAP OF VULNERABILITY IN KUPANG CITY

Vulnerability =

$$\frac{(\text{Exposure} \times \text{Sensitivity})}{\text{Adaptive Capacity}}$$

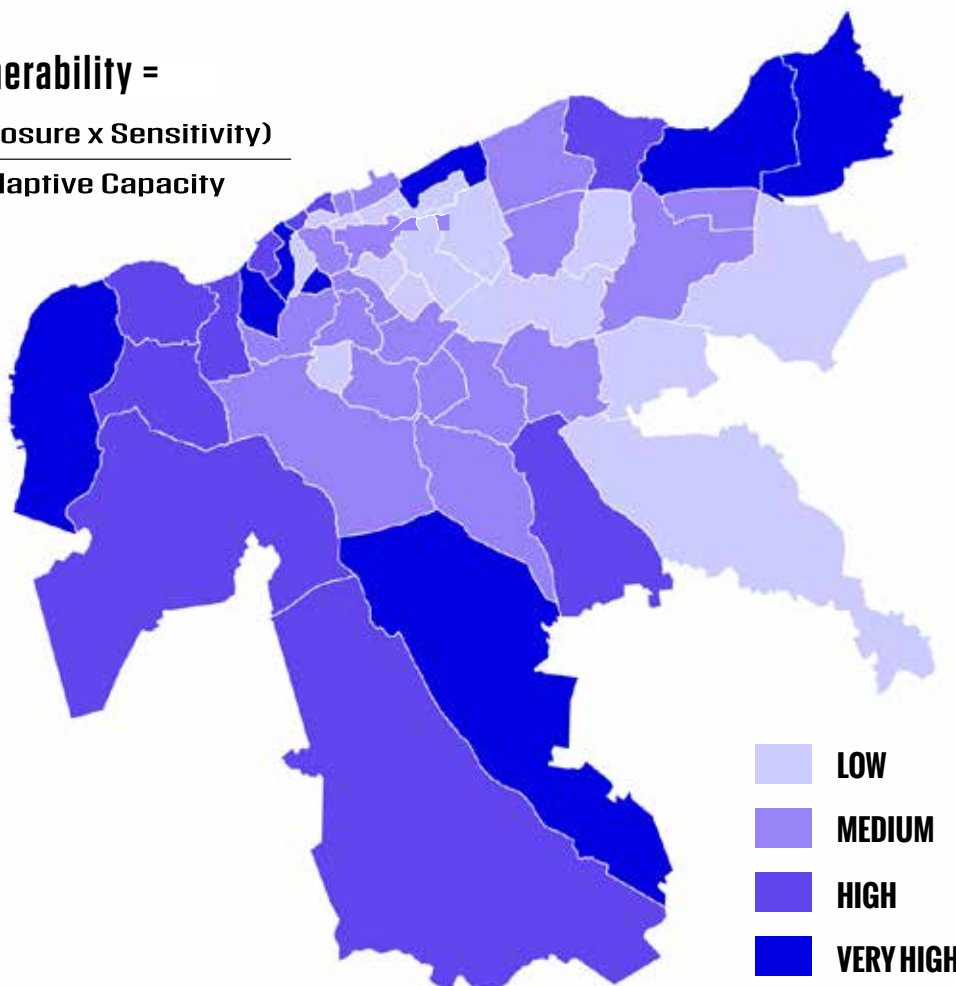


Figure 33. Consolidated map of the vulnerability of the city demonstrating the neighborhoods with highest levels of vulnerability to climate hazards

What is important to reflect upon is that evaluating vulnerability does not simply mean identifying the areas most exposed or with highest sensitivity. Because the formula divides these by adaptive capacity, it is important to understand where the city government currently has extended services, or has institutional capacity, to respond to climate hazards and disasters. For example areas with good roads, services, and medical facilities have high adaptive capacity, whereas those areas that are remote often have low adaptive capacity.

f. Reflections on Identifying Vulnerability in the City

The consolidated maps demonstrate the distribution of vulnerability across neighborhoods in the city. From the map we can see that along coastal areas, especially where there are high levels of migrant and urban poor populations, vulnerability is high. This is largely due to high levels of sensitivity. Coastal areas are much more exposed than inland areas because they face multiple climate hazards simultaneously. Given the complicated legal status of land (many settlements are occupations) and higher than average poverty levels, these neighborhoods require a combination of different measures, including increased social support, improved enforcement of regulations, as well as physical infrastructure, to reduce vulnerability.

Other neighborhoods such as Naoioni and Sikumana, which are located on the periphery of the city, or along steep ravines, also have very high vulnerability.

These areas are not yet fully urbanized, but the rapid expansion of the city, with new housing being built, contributes to increased vulnerability. Often there is not adequate planning, infrastructure and services, to accompany the sudden growth, and these areas also attract the poor (who may have moved on from, or forced out of, other areas of the city). Above all, water supply is a crucial factor to ensuring better resilience and outlying areas are vulnerable because population density is lower and there are fewer public services installed.

It is essential to remember that governments and communities do have the power to reduce vulnerability. By referring to the Vulnerability Formula we can understand that while it is very difficult to reduce Exposure, it is possible to increase Adaptive Capacity or reduce Sensitivity - both actions will have the effect of reducing Vulnerability. So people can do something. By focusing on specific measures to reduce sensitivity (such as social programs and better infrastructure), and improving adaptive capacity (for example improving government outreach programs and early warning systems), can reduce vulnerability.

For climate change vulnerability to be reduced, it is important that we do not rely up on indicators alone, because vulnerability is complex and can change for a variety of different reasons. It is important that the interests of specific groups are better understood, for example the way that women may experience periods of drought or strong winds, or the social and economic conditions situation of migrants, and other marginalized people like fishermen.

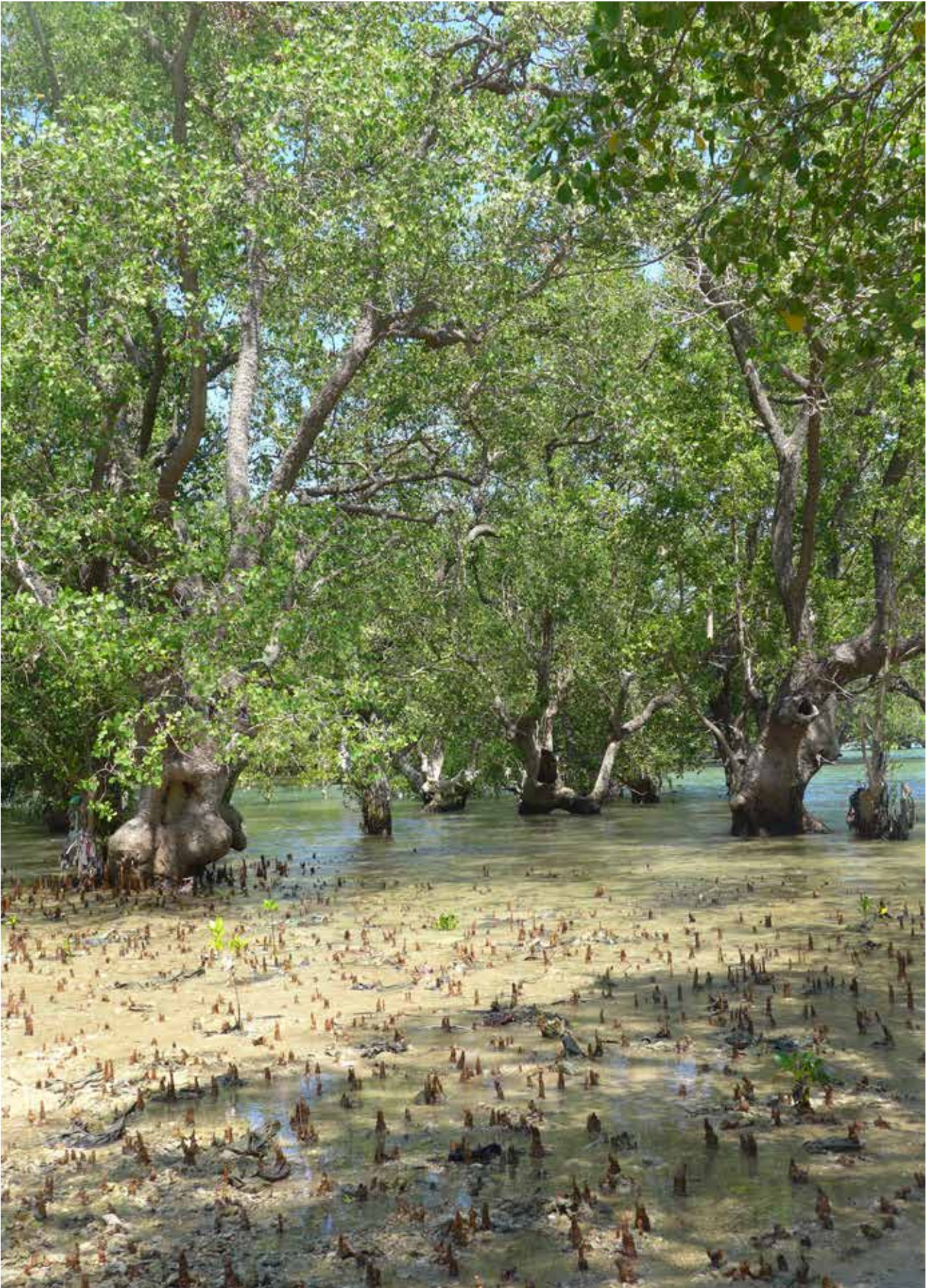


Figure 34. Mangroves are natural systems that can support the city in reducing its vulnerability to climate change by diminishing the force of high waves and winds, and also help promote coastal economies. Measure need to be taken to prevent their destruction, and promote mangrove restoration

7 Recommendations

The objective of the CCVA is to better understand the nature of climate change in Kupang and how it will affect the city. In effect, the idea is to raise awareness the CCVA cannot simply remain as a report – it should be disseminated and discussed, and influence the policies, plans, regulations and ultimately

lives of the city and its inhabitants. Here are some recommendations that were discussed together with the participants from different stakeholders both government representatives or civil societies during the CCVA and URMP Workshop held at 5-6 May 2015.

- 1** Raise Awareness and Build Capacity
- 2** Create Working Group (POKJA)
- 3** Regulations
- 4** Focus on vulnerable coastal areas
- 5** Water resource management
- 6** Protect the most vulnerable

1 RAISE AWARENESS OF COMMUNITY AND BUILD CAPACITY



Raise the awareness of local government and communities about climate hazards and vulnerability in the city. The campaign to raise awareness can be implemented through existing community groups, such as groups at village-level, and those organized by the Dept. of Marine and Fisheries. BKMG can play a more strategic role in disseminating information to community groups.

Build capacity about adapting to climate change, by training government, civil society organizations and community groups. Possible training modules can develop community skills to diversify livelihoods of vulnerable communities.

Responsible Agencies: Marine and Fisheries Department, Department of Social Welfare, BMKG, Scouts, Neighborhood Facilitator, RT, RW, Tagana, Village working groups, Department of Women’s Empowerment (SETDA), NGOs.

2 CREATE A CLIMATE ADAPTATION WORKING GROUP FOR KUPANG CITY (POKJA)



Creating a climate change adaptation working group, made up of key stakeholders, is essential. The working group will implement and lead initiatives to reduce vulnerability and implement adaptation policies. Community-level working groups can also be formed. The working group can learn from other initiatives around Indonesia and circulate knowledge to relevant groups and stakeholders in the city.

Responsible Agencies: Bappeda, Kecamatan, Kelurahan

3 PASS REGULATIONS TO ENSURE CLIMATE ADAPTATION IS A PRIORITY



New regulations and their enforcement are needed to support efforts to make climate change adaptation a priority in the city. Regulations should ensure regular review of data to assess vulnerability trends, particularly in vulnerable areas. This will help convert initiatives into action.

Responsible Agencies: Bappeda

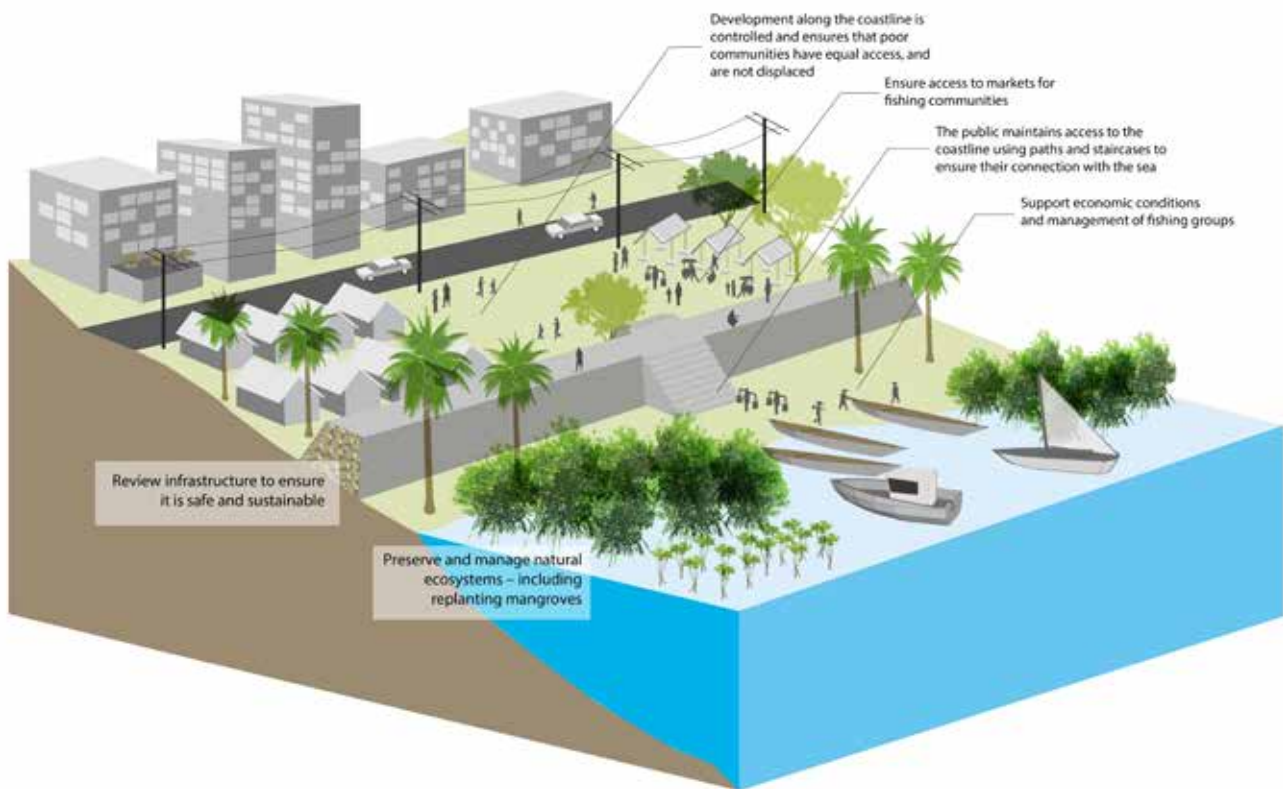
4 PROTECT THE MOST VULNERABLE



Efforts should focus attention on protecting the most vulnerable, including those living in areas at risk, female-headed households, groups of fishermen and their families, and those with little access to the market. Such measures should include:

- EMPOWERING FEMALE-HEADED HOUSEHOLDS AND POOR FAMILIES WITH LOANS AND SOCIAL PROTECTION PROGRAMS BY IMPROVING WELFARE POLICIES, AND ACCESS TO CAPITAL AND MARKETS.
- STRENGTHEN ECONOMIC CONDITIONS OF VULNERABLE COMMUNITIES ESPECIALLY IN FINANCIAL MANAGEMENT ETC... (SUCH AS FISHING GROUPS)
- UNDERTAKE COMPREHENSIVE REVIEW OF INFRASTRUCTURE TO ENSURE ITS SAFETY AND SUSTAINABILITY
- SOCIALIZATION AND LAW ENFORCEMENT (PERDA) ABOUT PROTECTION OF CHILDREN LABOR.

Responsible Agencies: Department of Social Welfare, Department of Social Prosperity, Department of the Environment, Department of Public Works.



Empower vulnerable coastal communities, in particular fishing communities. Activities include economic and development, enforcing regulations and building knowledge and skills to undertake conservation activities.

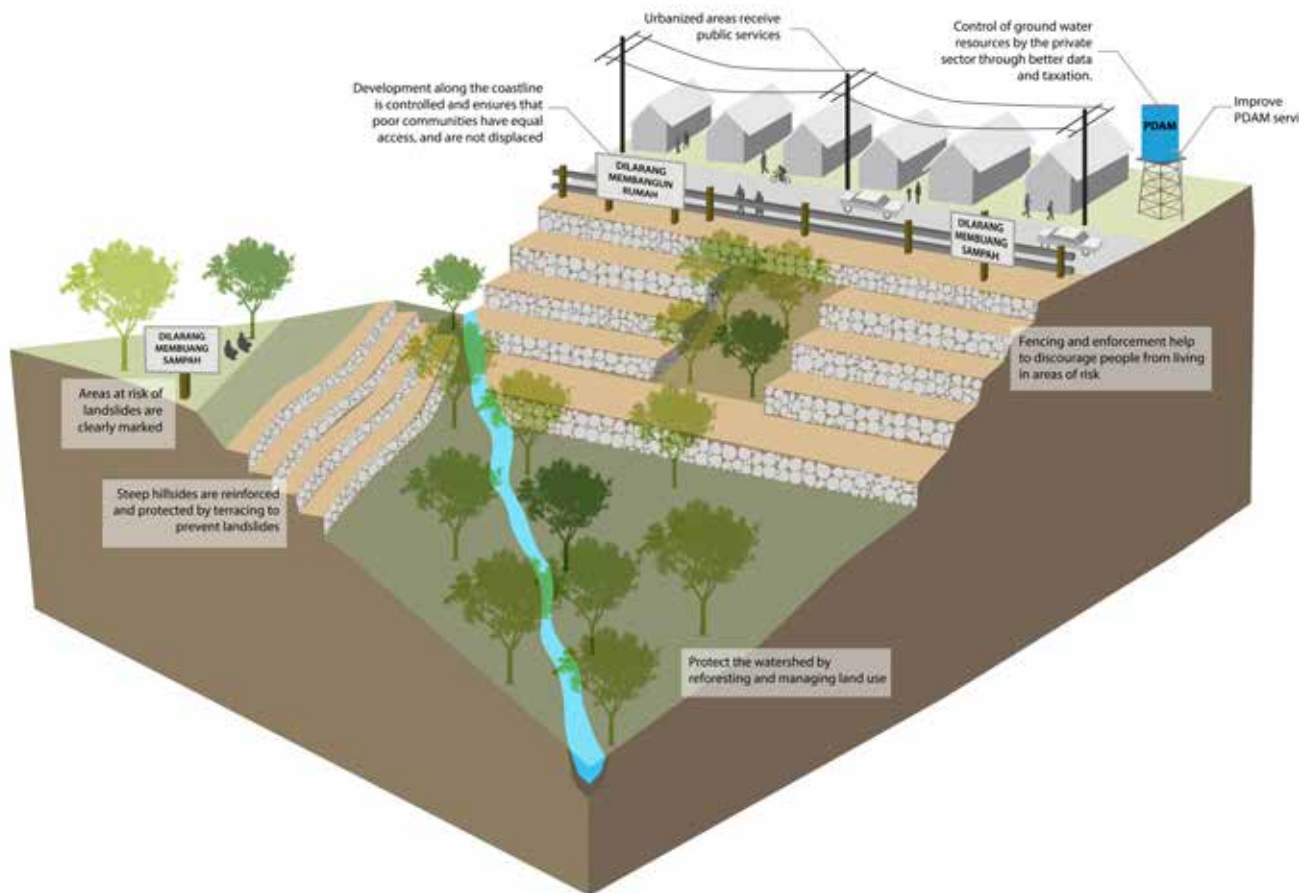
Development in coastal areas should be promoting:

- INVOLVING COMMUNITY GROUPS IN THE DISCUSSION AND CONSULTATION PROCESS
- PRESERVING NATURAL ECOSYSTEMS (CORAL REEFS, FISH ZONES, MANGROVES)
- STRENGTHENING ECONOMIC CONDITIONS OF VULNERABLE COMMUNITIES, SUCH AS FISHING GROUPS,

ESPECIALLY IN FINANCIAL MANAGEMENT ETC...

- UNDERTAKING A COMPREHENSIVE REVIEW OF INFRASTRUCTURE TO ENSURE SAFETY AND SUSTAINABILITY (EG. SEA-WALLS VS MANGROVES)
- IMPROVING SOCIAL PROTECTION PROGRAMS BY INCREASING ACCESS TO CAPITAL AND MARKETS.

Responsible Agencies: Department of the Environment, PDAM, Department of Public Works, Marine and Fisheries Department, Department of Urban Planning, Department of Social Welfare



Better management of scarce water resources is essential to the future of the city. The following actions should be taken:

- Controlling the use of groundwater resources, including use by the private sector. Clear permitting, taxation, and data collection systems are needed. At the moment there is no data available about the number of non-government bore wells, nor a permit system for groundwater use.
- Improving the quality of PDAM service. Both PDAM Kota and Kabupaten should focus on delivering

better service to the public throughout the city, through better coordination and communication.

- Conserving the city's watershed to protect water supply resources, including forestry and land use management.
- Creating the city's drainage master plan. Responsible Agencies: Department of the Environment, City and District level PDAM, Department of Public Works.

Responsible Agencies: Department of the Environment, City and District level PDAM, Department of Public Works.



Figure 37



KOTAKITA
A CITY FOR ALL