WFP
World Food Programme

SAVING LIVES
CHANGING LIVES

Philippine Climate Change and Food Security Analysis

Regional Report on National Capital Region

October 2024

Alliance
Bioversity & CIAT

Contributors

Jane Girly Cuerdo Balanza, Senior Research Associate, Spatial Modeler, Alliance of Bioversity International and CIAT, j.balanza@cgiar.org

Juanito G. Berja, Jr., MPM, National Vulnerability Analysis and Mapping (VAM) Officer – WFP Philippines, juanito.berja@wfp.org

Cover photo by WFP/Dale Rivera

Publication design by Christian Joseph Reyes and Vanessa Pamittan

October 2024

Suggested citation:
Alliance of Bioversity International and CIAT & World Food Programme. (2024). Philippine Climate Change and Food Security Analysis: Regional Report on National Capital Region. Manila, Philippines.

Acknowledgements

The Climate Change and Food Security Analysis project would not have reached significant milestones without the support of many people. Our deepest gratitude to the following people who extended their invaluable time and support in validating the livelihood zones map and in providing additional substantial data for climate change analysis.

To the following staff of WFP for the unparalleled energy and noteworthy inputs: **Mr. Mark Cervantes**, **Mr. Paris Kazis**, **Ms. Zuhaina Abubacar**, and **Ms. Sarah Cruz** (Manila Country Office), and to **Mr. Jonathan Austria** (University of the Philippines Foundation, Inc.).

To the experts during the consultations: **Arch. Ray C. Guarnes, EnP.**, **Ms**. **Laarni Magayanes, EnP.**, and **Ms. Patricia Sanchez** (DHSUD); **Mr. Joel Lorenzo C. Guevara** (DTI); **Dr. May Celine Vicente** and **Ms. Jezleer Montajes** (Manila Observatory).

Table of Contents

List of Tables

List of Figures

List of Abbreviations

4P	Pantawid Pamilyang Pilipino Program
AEZ	Agro-Ecological Zones
AMIA	Adaptation and Mitigation Initiative in Agriculture
ASEAN	Association of Southeast Asian Nations
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
CCFSA	Climate Change and Food Security Analysis
CCT	Conditional Cash Transfer
CLUP	Comprehensive Land Use Plan
DENR	Department of Environment and Natural Resources
DHSUD	Department of Human Settlements and Urban Development
DOST	Department of Science and Technology
DPWH	Department of Public Works and Highways
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographic Information System
KII	Key Informant Interview
LGU	Local Government Unit
LHZ	Livelihood Zone
MGB	Mines and Geosciences Bureau
MMDA	Metro Manila Development Authority
MODIS	Moderate Resolution Imaging Spectroradiometer
MT	Metric Ton
NAMRIA	National Mapping and Resource Information Authority
NCR	National Capital Region
NFPC	Navotas Fish Port Complex
NWRB	National Water Resources Board
PAHO	Pan American Health Organization
PDSI	Palmer Drought Severity Index
PIDS	Philippine Institute for Development Studies
PSA	Philippine Statistics Authority
SME	Small and Medium Enterprises
UNEP	United Nations Environment Programme
UNISDR	United Nations Office for Disaster Risk Reduction
USD	United States Dollar
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization

Foreword

Globally, the impacts of weather extremes, environmental degradation, and economic shocks continue to hamper people's access to nutritious and affordable food. Now, more than ever, strengthening the resilience of food systems is crucial, as this is the path where food travels from the farm to the table.

In 2021, the United Nations World Food Programme (WFP) conducted a robust study entitled Climate Change and Food Security Analysis (CCFSA), which assessed the interconnectedness of climate change and food security. To inform key actors of the Government and the private sector, CCFSA highlighted the trends and potential risks of climate change on food and nutrition security, and how they affect livelihoods in rural and urban areas of the Philippines.

Last year, WFP and the International Center for Tropical Agriculture (CIAT) expanded the CCFSA published in 2021. Five regional reports were produced based on quantitative and qualitative research conducted from May 2022 to October 2023. CIAT and WFP prioritized five areas for the sub-national level analysis, as these regions were not able to participate in the initial validation of the key results of the national-level research three years ago.

To that end, WFP presents the CCFSA regional report for the National Capital Region (NCR). The report interweaves i) climate change, ii) food and nutrition security, and iii) livelihoods and lays out ramifications and mitigation measures. Individual interviews and group consultations with representatives of key regional and national government institutions were also done to supplement the "ground truth" to the CCFSA findings.

To support policy development and resource management, this report provides government and non-government partners with a better understanding of interplay amongst natural hazards, crop suitability, and economy at the local level in NCR. It also presents base maps of major livelihood zones at the city and municipal levels, illustrating a visual representation of the main economic activities. These aim to i) enhance existing development and action plans and ii) help determine the most effective way to strengthen the adaptive capacity of the different localities to climate change.

The regional report can easily be updated since the CCFSA database can incorporate new datasets (small-area poverty estimates, agricultural production data, nutrition, etc.) from national and international government agencies and non-government organizations. CCFSA can also complement current government initiatives like the national colour-coded agricultural guide map of the Department of Agriculture and provide valuable information for smallholder farmers and fisherfolks.

WFP would like to extend its gratitude for the unwavering support of the national and regional partners and the analytical work of CIAT, which made possible the success of this research project.

WFP hopes that this analysis will support shaping policies, programmes, and investments at the local level to mitigate the effects of climate change and enhance the resilience of many Filipinos. As demonstrated through the past decades, WFP is committed to achieving food and nutrition security in the Philippines.

Regis Chapman
Representative and Country Director
UN World Food Programme, Philippines

Executive Summary

Following the conduct of the Climate Change and Food Security Analysis (CCFSA) and the development of a country-wide Livelihood Zone (LHZ) map in 2021, a follow-up project was conducted to validate the results at the regional level. Using spatial analysis, key informant interviews (KIIs), and consultations with relevant government and non-government agencies, the exposure and vulnerability of different livelihoods to climate change and climate-related hazards in the National Capital Region were analyzed.

The following are some of the key findings of the assessment:

Livelihood Zones

- Based on the recommendation of Department of Human Settlement and Urban Development (DHSUD), the term "Urban Livelihood Zone (LHZ)" was changed to "Built-up Areas LHZ" to be consistent with the terminology being used in Comprehensive Land Use Plan (CLUP) and Zoning Ordinance (ZO).
- Built-up Areas LHZ in the National Capital Region (NCR) was further characterized and classified into four (4) subclasses namely: Services Zone, Commercial Zone, Agriculture Zone, and Manufacturing and Industry Zone.
- Majority (52.54%) of the built-up areas in NCR are considered as Services Zones. Meanwhile, 20.92% are Commercial Zones, 8.35% are Manufacturing and Industry Zones, 4.00% are Agriculture Zones, and 14.19% are unclassified due to unavailability of data.

Susceptibility to Climate-Related Hazards

- The municipality of Pateros and City of Navotas have the highest level of susceptibility to flooding while majority of the areas in NCR have "Very Low" to "Moderate" values.
- Forty-one percent (41%) or seven (7) out of the 17 localities in NCR are highly susceptible to both sea-level rise and storm surge, namely: Pateros, Navotas, Malabon, Valenzuela, Marikina, Pasig, and Manila.

Impacts on Livelihood and Food Supply chain

- Direct impacts of climate-related hazards on built-up areas are physical damage to infrastructure and disruptions on basic services such as transportation. These can affect livelihood in all of the built-up area sub-classes, especially to areas that are highly susceptible to climate-related hazards, since mobility and operations are restricted.
- Shock in the transportation sector due to overlapping hazards of flooding, sea-level rise, and storm surge, can also affect the built-up areas' economy through constraints in the flow of goods and services resulting to the disruption in the food supply chain.

Impacts on Poor Households

- NCR has a relatively low percentage of poor households, mostly situated in Manila (29,974), Caloocan City (16,860), and Quezon City (12,238).
- Climate-related hazards have greater impacts on poor households since they have the least resources and least capacity to adapt.

Implications on Food Security

- Climate-related hazards affect food availability and accessibility which can lead to food insecurity.
- In NCR, data showed that the city of Navotas have the double burden of experiencing high prevalence of malnutrition and high susceptibility to climate-related hazards.
- Urban gardening is a potential adaptation strategy for built-up areas to ensure availability of food during climatic and economic risks.

1. Introduction

1.1. Project Background

The World Food Programme (WFP), in collaboration with the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), completed a national-level Climate Change and Food Security Analysis (CCFSA) in May 2021. The project aimed to assist the Philippine government in delivering its priority agenda of: 1) Reducing vulnerabilities of food systems and nutrition to long-term shocks and other climate-related hazards; and 2) Improving community resilience by understanding critical impacts of climate change on different aspects of food security.

One of the major accomplishments of the project was the development of a National-level Livelihood Zones (LHZ) Database. This tool can assist planners and policymakers in strategically assessing impacts of climate-related risks to food security and livelihoods through an accurate classification of LHZs at the city/municipal level. This site-specific information is important in crafting tailored recommendations that will support local-level climate change adaptation and promote climate-adaptive food systems.

In July 2022, a follow-up analysis was undertaken by the WFP and Alliance of Bioversity International and CIAT to validate the initial findings in four regions, namely: Region IV-B (MIMAROPA), Region XI (Zamboanga Peninsula), Region XII (SOCCKSARGEN), and the Bangsamoro Autonomous Region in Muslim Mindanao. Additionally, the CCFSA in the National Capital Region (NCR) was reviewed to further substantiate its urban analysis.

This report focuses on the **regional-level CCFSA for the NCR** which presents the validated livelihoods and climate-related profiles of the region. Additionally, this report identifies the specific locations of livelihoods in the NCR that are most at risk to climate hazards. This information can support the development of strategic adaptation plans at the local level that aim at minimizing the adverse climate-related impacts on livelihoods.

1.2. Initial Livelihood Zones

The LHZ database of NCR initially has a total of 17 records comprising 16 cities and one (1) municipality. All of these areas were classified as Urban LHZs in the initial CCFSA report.

2. Methodology

2.1 Study Site and Population

Study Site

The National Capital Region (NCR), otherwise known as the Metropolitan Manila or Metro Manila, is the Philippines' economic, political, and educational center. The smallest region in the country, NCR is home to 16 highly urbanized cities and one municipality: the nation's capital Manila, Caloocan, Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinlupa, Navotas, Parañaque, Pasay, Pasig, Quezon City, San Juan, Taguig, Valenzuela, and Pateros. To this day, NCR continues to function as the Philippines' premier metropolitan center and the seat of the national government.

NCR occupies the central part of Luzon with a total land area of 21,765 square kilometers (km^2). Unlike other regions that depend largely on the agriculture sector, NCR is a predominantly commerce and trade-driven region. In 2021, it registered a total of 201,080 established businesses, contributing to 33.6 percent of total employment in the country. The capital region also currently hosts five central business districts in Makati, Bonifacio Global City, Ortigas, Manila Bay Area, and Alabang.

Among all the 17 regions, NCR holds the highest average regional share in the national economy accounting for 37 percent of the gross domestic product (GDP) in the 2010 to 2018 period. The growth in the services and industry sectors prompted NCR to accelerate its construction and manufacturing areas, propelling the region to become the largest contributor to the country's production of goods and services at 31.5 percent of GDP.

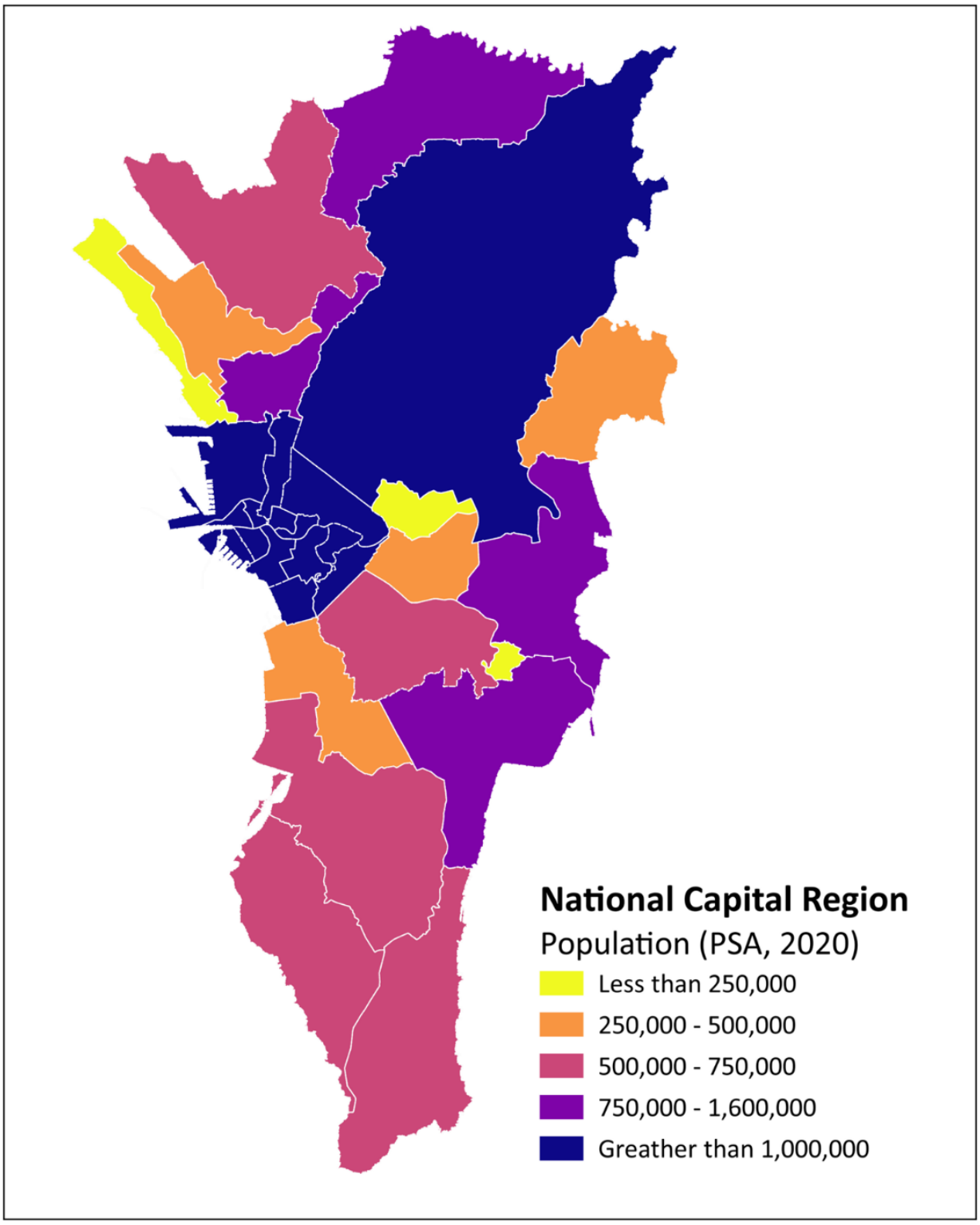
Population

As the most densely populated region in the Philippines, NCR is home to 13,484,462 Filipinos based on the 2020 Census of Population and Housing. This accounts for about 12.37 percent of the country's population in 2020. Of the four districts comprising Metro Manila, the second, eastern district tallies the biggest population with 4,771,371 individuals, while the lone district of the City of Manila is the smallest with only 1,846,153 constituents.

Quezon City tops all highly urbanized cities in the capital region with 2,960,048 residents, followed by the City of Manila (with numbers mentioned above), and Caloocan with 1,661,584 residents. The three cities have consistently posted high population densities since 2010.

Meanwhile, the lone municipality of Pateros registered the lowest number of populations in Metro Manila with only 65,227 residents. The other least populous cities in the region include San Juan with 126,347 residents and Navotas with 247,543 residents.

Figure 1. Population map of National Capital Region (PSA, 2020)



2.2. Livelihood Zones Mapping

The CCFSA utilized seven (7) different national datasets to build the LHZ database (Table 1). These datasets include Land Cover Map, Agro-Ecological Zones (AEZ), MODIS-derived Rice Extent Map, Tourism Areas, Mining Locations, the Land Classification from the Philippine Local Government Units (LGUs), and areas classified as industrial zones.

The datasets were processed using the Geographic Information System (GIS) software. All datasets were converted into a shapefile format for uniformity. Standardizing data allows better processing of statistical information at a more granular level. Furthermore, the use of data at the city/municipal level enables a more comprehensive and up-to-date analysis that is beneficial for socio-economic planning and development.

Table 1. Data sources for the LHZ database

Layer	Source	Data Type	Resolution	Time Period
Land cover	National Mapping and Resources Information Authority (NAMRIA)	Polygon	1:10,000	2015
Agroecological zones	Department of Agriculture	Polygon	1:10,000	2016
Rice extent	International Rice Research Institute	Raster	250m x 250m	2015
Mining locations	Department of Environment and Natural Resources	Point, Tabular	Municipal scale	2015
Tourism areas	Philippine Geoportal	Point	Municipal scale	2015
Local Government Unit Category	Philippine Statistics Authority	Tabular	Municipal scale	2015
Industrial zones	Local Government Units	Tabular	Municipal scale	2015 up to latest year

The Spatial Overlay operation in GIS was employed to identify the spatial relationships among the different thematic maps in Table 1. All of the datasets and attributes were superimposed and analyzed within a polygon[1] which represents a city/municipality. Using this technique, different combinations of data were formed which allowed to analyze portions of the various layers within polygons. The

[1] Polygon feature is a closed shape defined by a connected sequence of x and y coordinate pairs. It is a geographic representation of an area and location (ESRI).

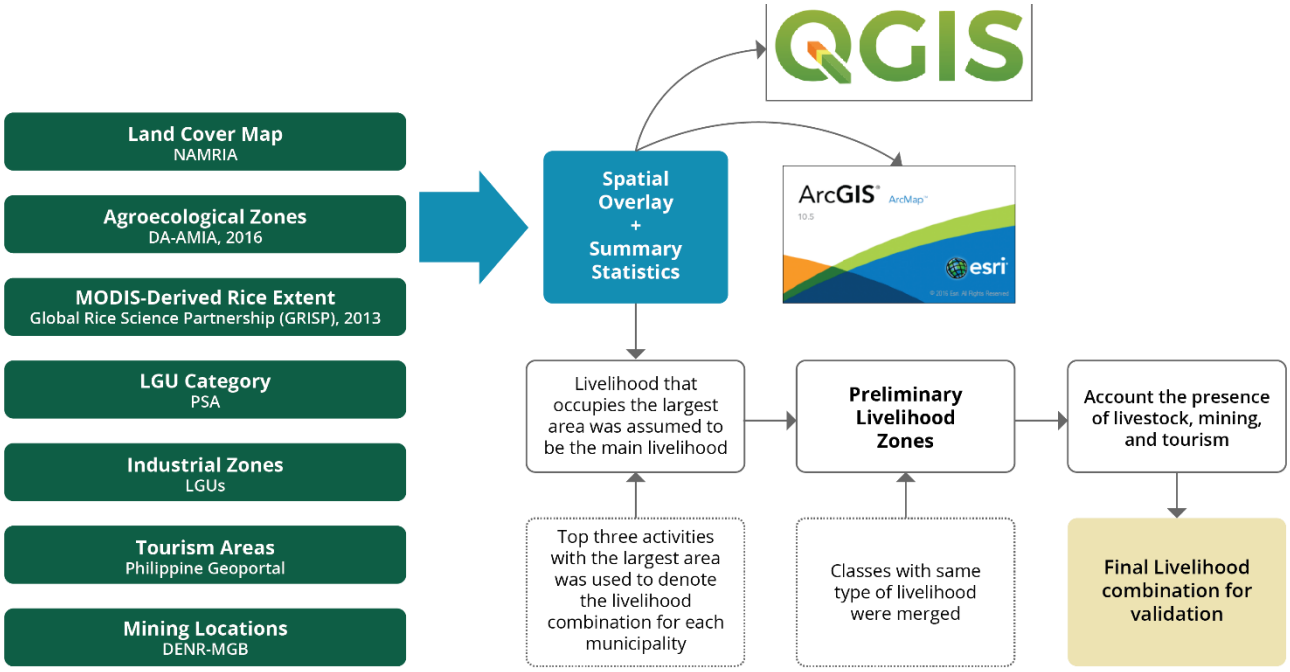
resulting layer contains new attribute information which formed the LHZ based on the percent area that an activity/livelihood occupied within the polygon. Duplicates and overlaps among the attributes (i.e., land cover, agro-ecological zones, and rice extent) were eliminated using the erase tool to further refine the output.

To determine the extent of each type of livelihood, the area in hectares (ha.) being occupied by a specific activity was calculated using the Summary Statistics Tool. The activity that occupied the largest area in each city/municipality was considered as the Major Livelihood. On the other hand, the succeeding activities that occupy the next largest areas were identified as Secondary, Tertiary, or Quaternary Livelihoods, accordingly.

The additional datasets on tourism and mining are all point data[2] which were computed as counts per polygon. Also, livestock activities were just classified as "Yes" (present) or "No" (lacking), and therefore, has no geographical extent. Nevertheless, presence of these activities was still accounted for and included in the analysis whenever identified in a particular city/municipality.

Based on the analytical method shown in Figure 2, a livelihood zone unit can be defined as an area that occupies one position on the map with a resolution at a city/municipal level, which contains similar attributes on livelihood activities based on agroecology, land use characteristics, and dominant economic activities within a production system.

Figure 2. Process flow in GIS for the Livelihood Zones development and mapping



[2] Point data does not allow for geographical extent or area calculation. In a map, point data is normally shown as point feature representing location or presence of tourism or mining areas.

2.3. Climate-Related Hazards Mapping

To identify and qualify the major climate-related risks prioritized in the initial phase of the project, six (6) datasets on hazards were used to characterize the exposure of the Philippines to climate variability and extreme weather events. These hazards include Typhoon, Flooding, Drought, Storm Surge, Saltwater Intrusion, and Sea Level Rise (Table 2). The selection of these hazards was based on the availability of data at the city/municipal level and the hazard's potential impact on livelihood, food security, and nutrition. For the case of NCR, flood, sea-level rise, and storm surge were used in the analysis of the Built-up LHZ.

Table 2. Overview of hazard datasets for the Philippines

Parameter	Source	Unit of Measurement, Spatial and Temporal Resolution
Typhoon	United Nations Environment Programme (UNEP)/United Nations Office for Disaster Risk Reduction (UNISDR) (2013) (https://preview.grid.unep.ch/) WFP Philippines	1-km pixel resolution. Estimate of tropical cyclone frequency based on Saffir-Simpson scale category 5. (> 252 km/h) from 1970 to 2013; typhoon tracks
Flooding	Mines and Geosciences Bureau, Department of Environment and Natural Resources (DENR-MGB)	1:10,000 scale. Susceptibility of flood risk for the Philippines, average of 10 years (2008-2017).
Drought	TerraClimate (Abatzoglou et al., 2018); Palmer Drought Severity Index (PDSI) from 1950 to near present	PDSI, Standard Precipitation Index
Storm surge	Adaptation and Mitigation Initiative in Agriculture (AMIA) multi-hazard maps/baseline data from Disaster Risk and Exposure Assessment for Mitigation, Department of Science and Technology (DREAM, DOST)	1:100,000 scale (resampled). Exposure of an area to storm surge
Saltwater intrusion	AMIA multi-hazard map/baseline data from the NWRB	1:100,000 scale (resampled). Risk of saltwater intrusion
Sea level rise	AMIA multi-hazard map	1:100,000 (resampled). 3-meter sea-level rise

2.4. Validation of the Livelihood Zone Classifications

To substantiate the LHZ classification of the localities in NCR, data from relevant institutions and urban experts were utilized. In consultation with the Department of Human Settlement and Urban Development (DHSUD), the built-up areas in NCR were validated and further characterized based on land classifications from available Comprehensive Land Use Plans (CLUPs). Table 3 shows the list of CLUPs used for the validation.

Table 3. List of CLUPs used for the validation of the built-up areas in NCR

	CLUP (Year)	Source
Caloocan	2016-2025	DHSUD
Las Piñas	2009-2024	MMDA Flood Control Plan
Makati	2013-2023	DHSUD
Malabon	2018-2027	DHSUD
Mandaluyong	2017-2032	DHSUD
Manila	No data available	
Marikina	No date	Marikina City Development Authority Planning
Muntinlupa	2016-2026	Muntinlupa City Planning and Development Office
Navotas	2016-2025	DHSUD
Parañaque	2008	Housing and Land Use Regulatory Board - Library
Pasay	2014-2022	Pasay City Planning and Development Office
Pasig	No date	MMDA Flood Control Plan
Pateros	No data available	
Quezon City	2011-2025	DHSUD
San Juan	No data available	
Taguig	No data available	
Valenzuela	2019-2028	Valenzuela City Planning and Development Office

Also, data of gainful workers[3] (Annex 1) was used to identify the specific type of livelihoods in each city/municipality, as recommended by the Department of Trade and Industry (DTI). Furthermore, Urban Experts from WFP were consulted to gain more insights on other relevant data which can be used for urban analysis.

[3] A person is considered as a gainful worker or usually working most of the time during the past 12 months if he/she works for at least 10 hours a week for six months (26 weeks) or longer, including vacation or sick leave, in one or more of these classes of work: 1) work for pay (wage, salary, commission, tips, and others); 2) work for profit in own farm, business, private practice of a profession or trade; and 3) work without pay on own family farm or business. (https://psada.psa.gov.ph/catalog/16/variable/F6/V82?name=OCC)

3. Results

3.1. Analysis of the Initial Livelihood Zones

The LHZ database of NCR had a total of 17 records corresponding to one (1) municipality and 16 cities. Initially, the NCR was classified as an Urban LHZ, however, it was renamed as "Built-up Areas LHZ" as recommended by the DHSUD, to be consistent with the terminology being used in the development of Comprehensive Land Use Plans (CLUPs) and Zoning Ordinances (ZOs).

3.2. Subclasses of Built-up Areas LHZ in NCR

The characterized Built-up Areas LHZ map of NCR is presented in Figure 3 showing the four (4) identified subclasses within the region.

Using the available land use maps in NCR and in consultation with the experts, the Built-up Areas LHZ was further characterized and classified into four (4) subclasses namely: **Services Zone**, **Commercial Zone**, **Agriculture Zone**, and **Manufacturing and Industry Zone**.

Based on DHSUD and PSA definitions, Services Zone refers to the sectors under armed forces, clerical support, elementary occupations, professionals, managers, and transport. On the other hand, Commercial Zone pertains to areas used for retail and wholesale trading, other services, and other business purposes. Agriculture Zones are those areas dedicated to work related to skilled agricultural, forestry, and fishery sectors. Lastly, Manufacturing and Industry Zone refers to industrial lands mainly used for industrial purposes such as manufacturing, processing, assembly, packaging, and industrial warehousing activities.

Results of the characterization revealed that the built-up areas in NCR are largely under the Services Zone (52.54%), followed by Commercial Zone (20.92%), Manufacturing and Industry Zone (8.35%), and few areas with Agriculture Zone (4.00%), as shown in Figure 4. Las Pinas City and Marikina City are the top two (2) cities having large area under Services Zone with a percent area covered of 76% and 73% respectively. For Commercial Zone, Pasay City (40%), Makati City (37%), and Paranaque City (36%) have the highest area covered. Meanwhile, Valenzuela City and Malabon City have the largest Manufacturing and Industry Zones of 29% and 25%, respectively. Lastly, majority of the Agriculture Zone is located in Navotas City, having 35% which is mainly dedicated for fishery-related activities.

On the other hand, the cities of Manila, San Juan and Taguig, and the municipality of Pateros were not classified due to unavailability of land use maps.

Figure 3. Characterized Built-up Areas LHZ in NCR

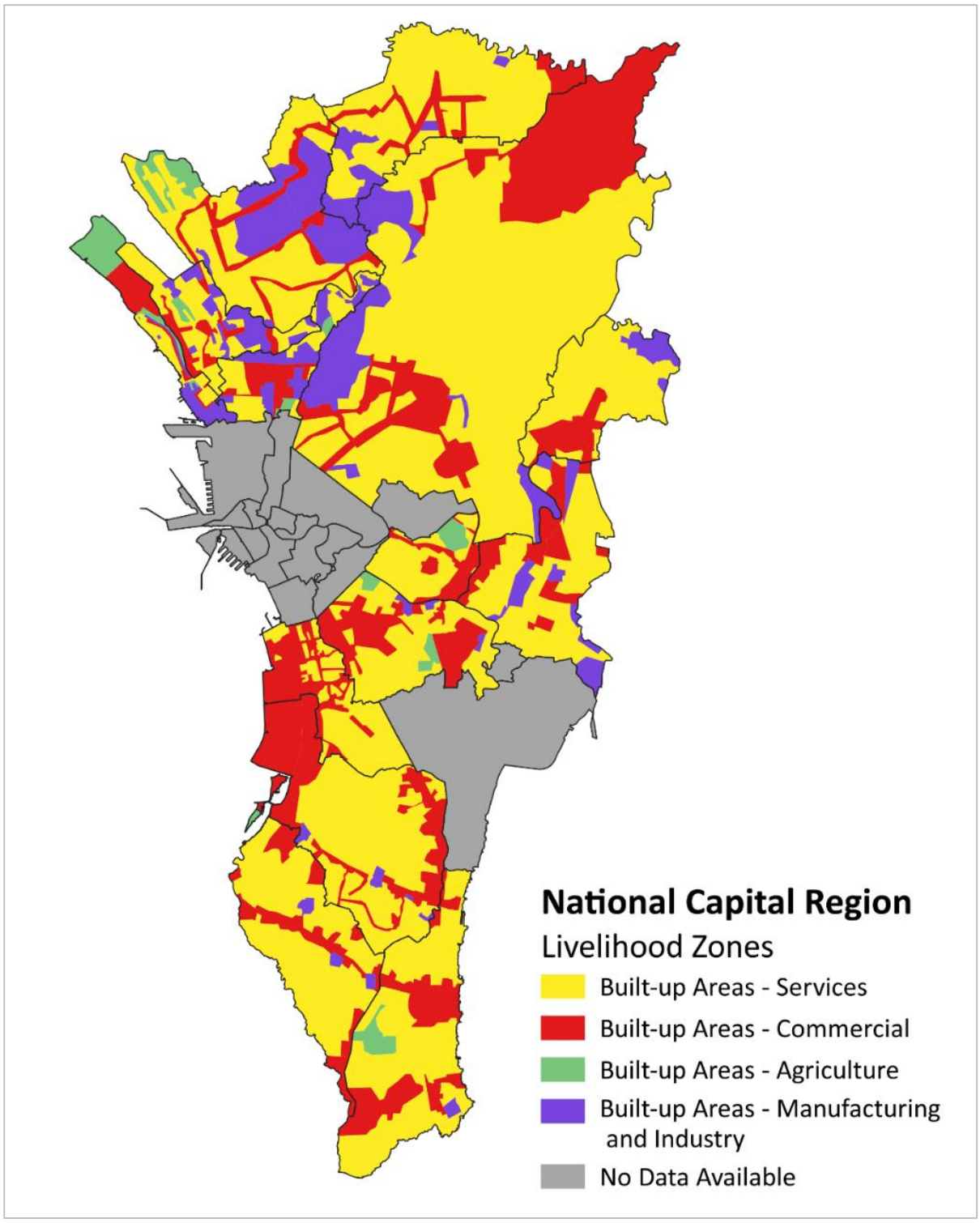
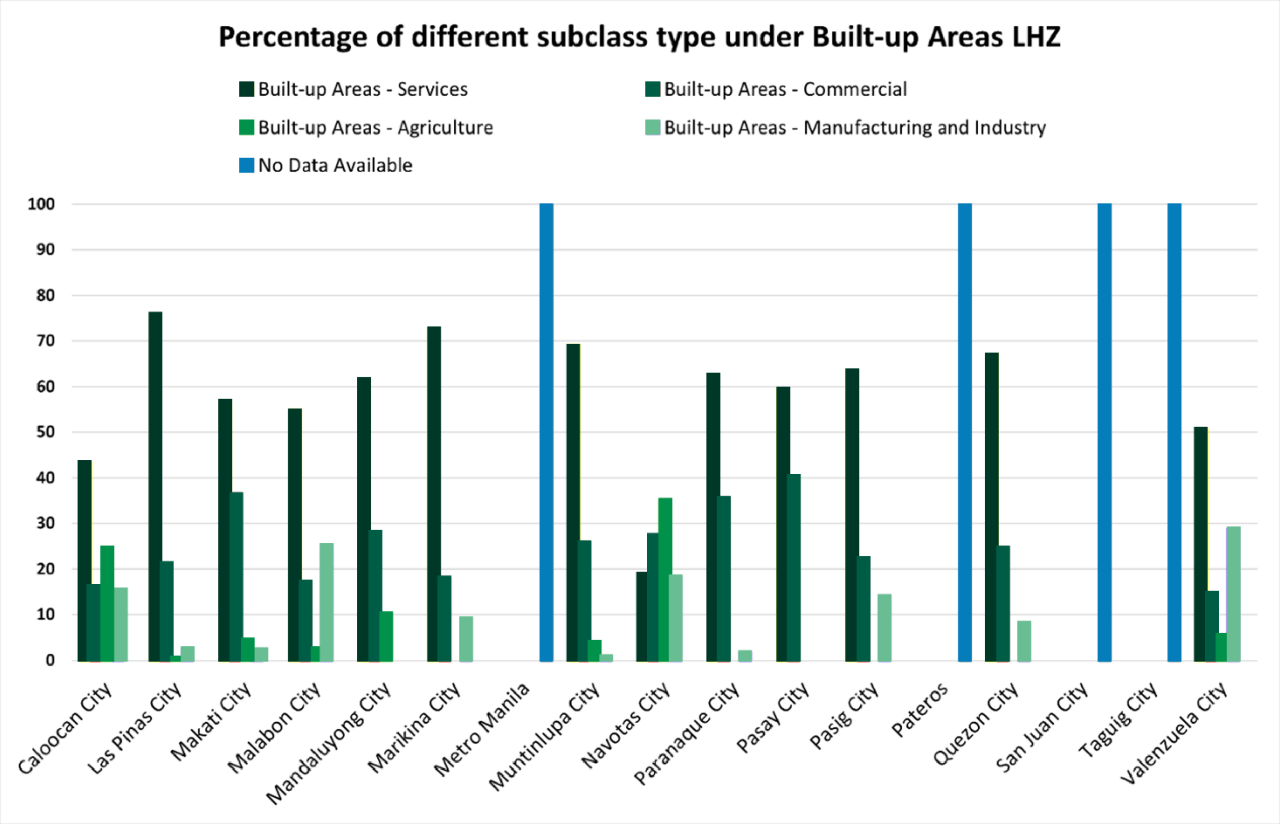


Figure 4. Percentage of area covered by the different types of sub-classes of the Built-up Areas LHZ in NCR



While Marikina City and Pasay City have the largest areas under the Services Zone, data on gainful workers from the PSA showed that Quezon City, Manila, and Caloocan were the top three (3) cities with the highest population of working class (15 years old and above) under the services sector in 2018 (Table 4). These three (3) cities also had the highest number of gainful workers under the Commercial Zone.

Furthermore, data also shows presence of population under the informal economy. These are the occupations that are not reported and was classified as other or working elsewhere which might not cover the exact number of people under this sector within the region.

Table 4. Number of gainful workers 15 years old and over under the different sectors (PSA, 2018)

City/ Municipality	Service Sector	Commercial	Manufacturing & Industry	Agriculture Sector	Informal Sector
Caloocan City	286,518	142,253	225,949	8,445	928
Las Pinas City	126,624	54,501	73,978	913	497
Makati City	169,862	51,949	64,332	1,036	1,278
Malabon City	67,366	33,519	50,160	3,206	147
Mandaluyong City	96,041	34,060	45,837	806	823

Manila	386,655	190,449	163,486	2,014	3,347
Marikina City	99,960	36,730	54,575	668	551
Muntinlupa City	94,856	48,135	70,591	5,588	2,031
Navotas City	44,196	24,146	28,191	15,586	148
Paranaque City	154,331	67,588	84,881	1,181	2,587
Pasay City	94,062	58,972	139,570	1,173	593
Pasig City	179,405	63,812	91,017	743	1,096
Pateros	13373	5377	128,470	67	79
Quezon City	658,634	272,680	347,482	4,080	13,554
San Juan City	33,415	12,537	10,971	119	1,338
Taguig City	-	0	-	-	-
Valenzuela City	118,318	48,756	102,161	3,144	253

3.3. Susceptibility to Climate-Related Hazards

3.3.1. Susceptibility to Flood

Flooding has been a perennial problem in NCR given that the Philippines is frequently hit by typhoons annually. Result of the hazard mapping, as shown in Figure 5, shows that majority of the areas in the region is moderately susceptible to flooding. Table 5, on the other hand, details the level of susceptibility to flooding of all the cities/municipality in NCR.

The municipality of Pateros (Very High) and Navotas City (High) have the highest level of susceptibility to flooding in the region. Meanwhile, the cities of Malabon, Valenzuela, Marikina, Pasig, and Manila were found to be moderately susceptible. Other areas have “low” to “very low” results. The aforementioned areas, particularly Pateros, Navotas City, Marikina City, and Pasig City have poor soil drainage, a shallow water table, and low soil stability making them susceptible to flooding (Pornasdoro et. al., 2014)[4].

[4] https://conference.surp.upd.edu.ph/downloads/JURP1/JURP_04_PORNASDORO_arial_lines_05a.pdf

Figure 5. Flood susceptibility map of NCR

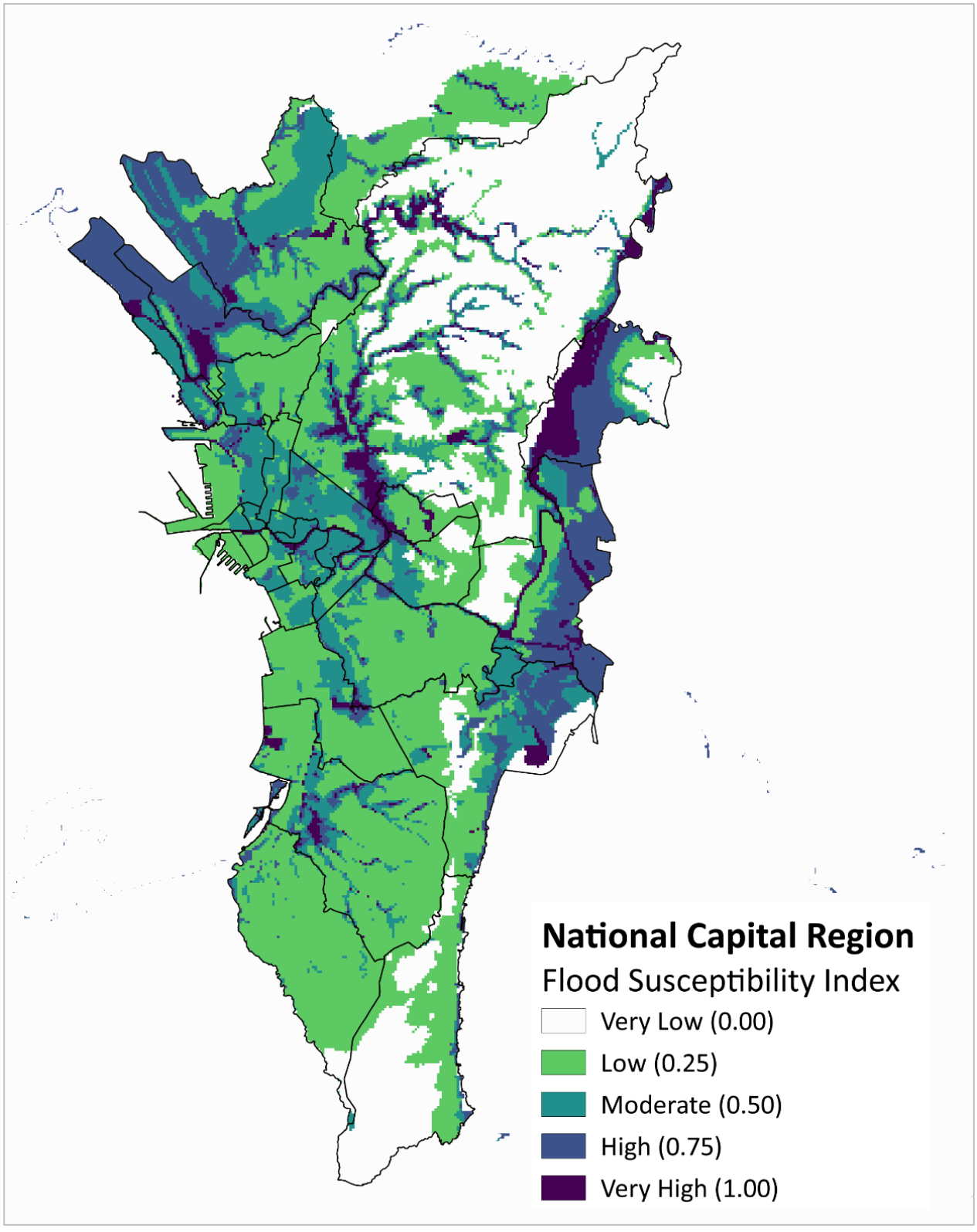


Table 5. Level of susceptibility to flooding of cities/municipality in NCR

Level of Susceptibility	City/Municipality
Very High	Municipality of Pateros
High	Navotas City
Moderate	Malabon City, Valenzuela City, Marikina City, Pasig City, Manila City
Low	Taguig City, Mandaluyong City, San Juan City
Very Low	Makati City, Parañaque City, Pasay City, Quezon City, Caloocan City, Las Piñas City, Muntinlupa City

3.3.2. Susceptibility to Sea Level Rise and Storm Surge

Based on the result of the hazard mapping, the Municipality of Pateros, and the cities of Navotas, Malabon, Valenzuela, Marikina, Pasig, and Manila are highly susceptible to the impacts of sea level rise and storm surge as shown in Figures 6 and 7, respectively.

The National Mapping and Resource Information Authority (NAMRIA) reported that sea level in NCR has already risen by an average of 8.4 mm a year from 1901 to 2022 which accounts to almost three times of the global average of 3.4 mm per year during that period (Subingsubing, 2023)[5]. Inundation from sea level rise would have significant consequences especially to low-lying coastal zones, many of which are clustered in urban areas such as NCR (Keller, 2013)[6].

Storm surges may also be induced due to the rising of sea level. As shown in Figure 7, areas that are highly susceptible to sea level rise also recorded the highest incidence of storm surge in NCR.

In 2013, a storm surge of over seven meters due to Typhoon Haiyan devastated several areas in the Visayas region which killed approximately 6,300 people (Luma-ang, 2020). A simulation study by Lapidez et. al. (2015)[7] using the Typhoon Haiyan conditions revealed that NCR is among the top 30 areas in the Philippines which may experience a high storm surge level. Specifically, extreme weather conditions were found to result to a maximum surge height of 3.90 meters in NCR particularly in the areas previously mentioned.

[5] https://newsinfo.inquirer.net/1818597/sea-level-rise-in-ph-capital-exceeds-global-norm-namria
[6] https://sites.tufts.edu/gis/files/2013/11/Keller_Lauren.pdf
[7] https://nhess.copernicus.org/articles/15/1473/2015/nhess-15-1473-2015.pdf

Figure 6. Sea-level rise susceptibility map of NCR

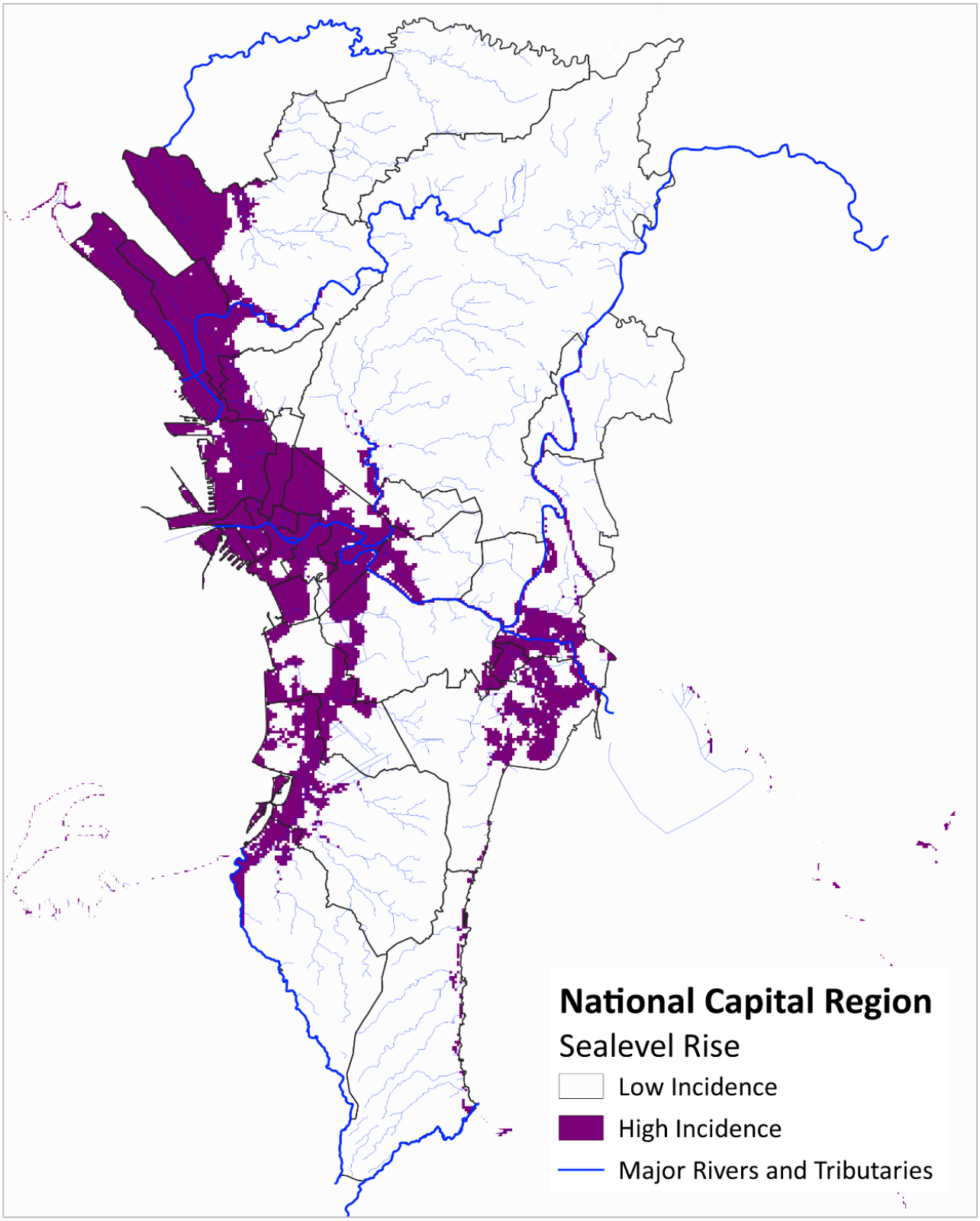


Figure 7. Storm surge susceptibility map of NCR

Table 6. Level of susceptibility to Sea Level Rise and Storm Surge of cities/municipality in NCR

Level of Susceptibility	City/Municipality
High	Municipality of Pateros, Navotas City, Malabon City, Valenzuela City, Marikina City, Pasig City, Manila City
Low	Taguig City, Mandaluyong City, San Juan City, Makati City, Parañaque City, Pasay City, Quezon City, Caloocan City, Las Piñas City, Muntinlupa City

3.4. Impacts of Climate-Related Hazards

3.4.1. Impacts on Livelihood and Supply Chain

The rising of sea level may induce storm surges and increase incidence of flooding, particularly in highly susceptible areas as discussed in Sections 3.3.1 and 3.3.2. Most notably, the municipality of Pateros and the city of Navotas consistently ranked the highest in terms of susceptibility to the three hazards that were analyzed.

For the municipality of Pateros, the unavailability of its CLUP limits the analysis of impacts of the hazards on the type of livelihood's subclasses. However, available literature shows that agricultural activities are still dominant within its built-up areas. In the recent report from DOST-NCR, livelihood in Pateros is mainly focused on *balut*-making and salted egg production (Ignacio, 2020). Moreover, Pateros was once host to a multitude of duck farms and *balut* houses which promote traditional method of incubating eggs (Rocamora, 2019). Among the significant impacts flooding on these livelihoods are contamination of the egg products, decreasing their market value; reduction in stocking density and shortages in production; and damage to infrastructure and facilities in production areas.

Similarly, the city of Navotas is dominated by the agriculture subclass which comprises skilled agriculture and fishery workers. According to the Partners for Resilience (n.d.)[8], the fishing industry is the major source of livelihood of more than 90% of the population of Navotas City. There are 7,538 registered fisherfolk in the city, representing only those who have registered fishing boats or vessels, and does not yet include divers, shell gatherers, sea laborers, and other fishery-related workers. Manila Bay provides the city with a bountiful source of fish and other fishery products; however, the impacts of climate change and other anthropogenic activities have negatively affected the production and income of fisherfolk in the recent years. According to the Partners for Resilience (n.d.), fisherfolk in Navotas attribute the low catch rates to fish moving into deeper water due to the continuous coastal degradation and loss of fish habitat. To augment the loss of income, the study of Partners for Resilience

[8] https://rilhub.org/wp-content/uploads/2020/07/Factsheet_Navotas-City_TLMv_2201811_compressed.pdf

also revealed that fisherfolk divert to informal jobs such as pedicab driving, especially during rainy seasons when fishing is not viable.

Additionally, the Navotas Fish Port Complex (NFPC) located in Navotas City is the third largest fish port in Asia, and the largest in the Philippines and Southeast Asia (PFDA, 2016). This fish port serves as the major drop-off area of agriculture and fisheries products all over the country (PSA, n.d.)[9]. Flooding, sea-level rise, and storm surge induced by typhoons, can lead to damaged infrastructures such as fish port complexes, breakwaters, barriers, and fishing vessels. This can directly affect the operation of fish ports and the unloading volume of fish supply. For instance, reports show that the Navotas Fish Port Complex had lower unloading of volume of fish supply from 3,500 MT to 3,088 MT due to typhoon Bising in 2021 (Cudis, 2021).

Flooding, sea-level rise, and storm surge have also wide-ranging impacts on other livelihood subclasses in NCR such as the Services, Commercial, and Industrial zones. Based on Figure 2 (LHZ map) in section 3.2, NCR is largely dominated by the Services zones comprising 52.54% or more than half of the land area of the region. It was followed by Commercial zones (20.92%) and Manufacturing and Industrial zones (8.35%).

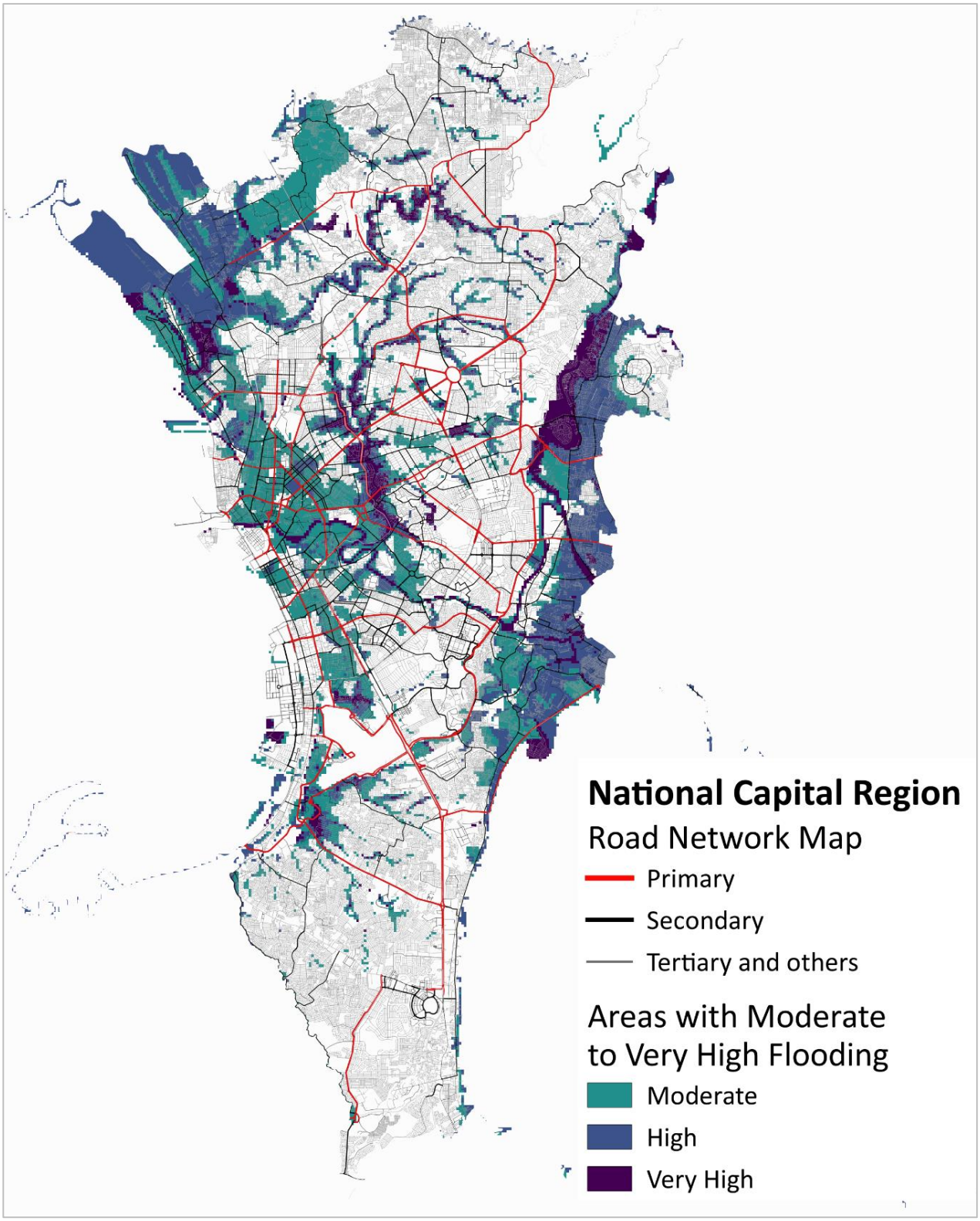
For areas under the Service zone, flooding can disrupt transportation services due to road closure and damaged transport infrastructure. These disruptions can greatly affect the ability of people to reach their work places, as well as for customers to access services.

The map shown in Figure 8 overlays data on flood susceptibility and transport network in NCR. Some of the major roads in the region are in the cities of Marikina and Pasig, both of which were found to be moderately susceptible to flooding. The Marikina-Infanta Road, a National Secondary Road which connects the provinces of Rizal, Laguna, and Quezon to NCR, is found in Marikina City. On the other hand, the Circumferential Road 5 (C5) in Pasig is a major circumferential road in NCR which serves as an important route for eastern and southern areas of the region, and connects several cities such as Las Pinas, Makati, Paranaque, Pasay, Quezon City, Taguig, and Valenzuela (DPWH, 2022). Limiting access to these roads, especially during flood events, will have direct and indirect impacts to Marikina, Pasig, and the whole of NCR and its nearby provinces. Direct impacts may include physical damage to infrastructure, traffic congestion, and travel time delays. Chang et. al. (2011) as cited by Bacero and Fillone (2023) said that a total delay of eight hours in travel time may result to a total freight delay cost amounting to 2,971 USD. Indirectly, this may cause system-level failure and socio-economic damages due to the disruption in the flow of goods and services.

For instance, the flooding due to Typhoon Ondoy in 2009 had inundated almost 90% and 85% of the land area in the cities of Pasig and Marikina, respectively (Tuaño et. al., 2018). This impaired road networks, bridges, electricity, telecommunications, and water systems which disrupted critical services, taking toll on the economy of Pasig and Marikina. Tuaño et. al. (2018) estimated that both cities may have lost PHP 22.54 billion, 90% of which represent the loss of Pasig City.

[9] https://rssoncr.psa.gov.ph/agriculture

Figure 8. Road network map overlaid with flood susceptibility map of NCR



For Commercial zones, disruption of transportation services due to flooding will affect operations of retail stores, restaurants, mall, and other establishments. The supply chain can also be affected due to the delay in the delivery of goods and services leading to increased operation costs for businesses and potential increase in prices which will affect the consumers. In particular, small and medium enterprises (SMEs) suffer the most to flooding and other climate-related hazards since they have limited access to a broader set of adaptation strategies and are generally less prepared for climate-related disasters (Ballesteros and Domingo, 2015)[10]. All these impacts of flood-associated hazards ultimately lead to loss of revenue for commercial businesses, as well as temporary loss of employment for the working class.

Under the Manufacturing and Industrial Zones, major impact of flood waters is damage to machinery and equipment, and damage to inventory for warehouses and industries that store raw materials. This damage may lead to production delays which can affect the production schedules, resulting to the disruption in the supply chain.

3.4.2. Impacts on Poor Households

Several studies have already shown that climate change have greater impacts on the poor and vulnerable sectors due to socio-economic inequalities. According to the World Bank (2009)[11], the poor have greater risks from climate-related hazards because they have the least resources and the least capacity to adapt.

For NCR, data shows that it had low poverty incidence of 2.83% in 2020. As seen in Figure 9, the cities of Manila, Caloocan, and Quezon had the top three highest number of poor households in the region. However, considering the number of households per city, it can be seen in Table 7 that Quezon City, the most populous area in NCR, had one of the least percentages of poor households, while Manila City and Caloocan City remained as the areas with the highest rate of poverty together with Malabon City.

[10] https://www.econstor.eu/bitstream/10419/127030/1/pidsdps1520_rev.pdf
[11] https://documents1.worldbank.org/curated/en/534871468155709473/pdf/521760WP0pover1e0Box35554B01PUBLIC1.pdf

Figure 9. Number of poor households per city/municipality in NCR

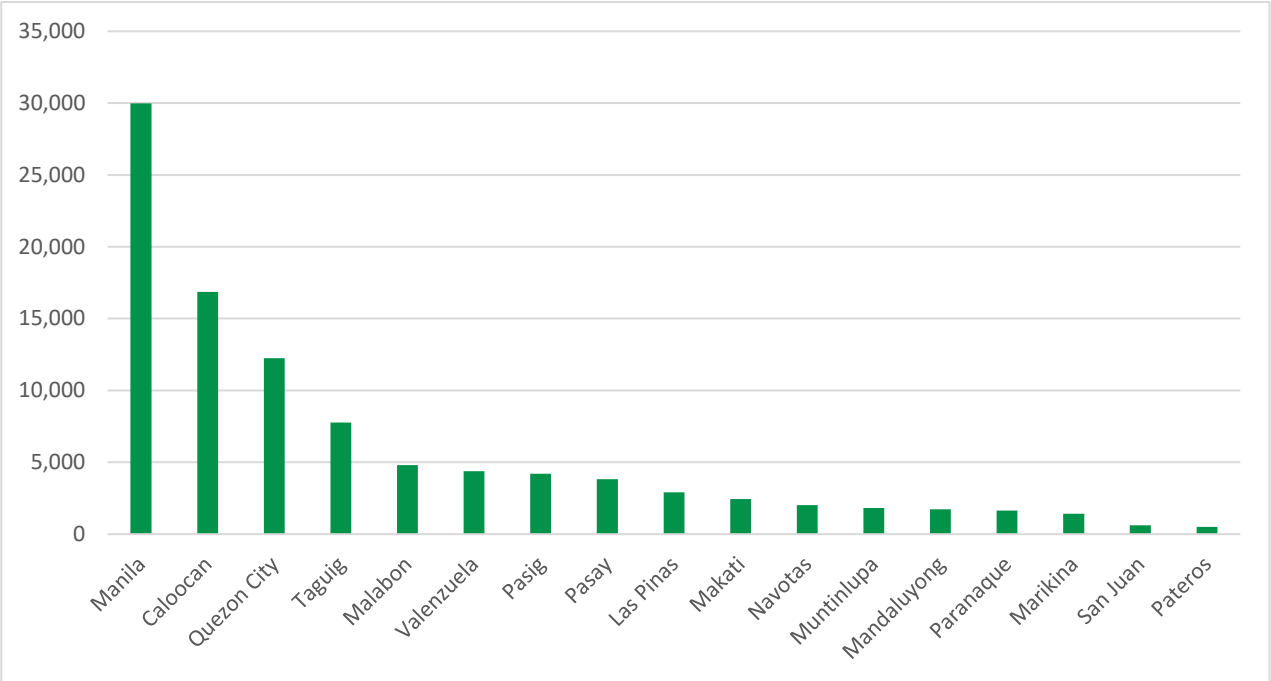


Table 7. Percentage of poor households per city/municipality in NCR

City	Poor Household[a]	Total Household[b]	Percent Poor
Manila	29,974	486,293	6.16
Malabon	4,806	94,241	5.1
Caloocan	16,860	404,252	4.17
Pateros	508	15,838	3.21
Navotas	2,022	63,167	3.2
Taguig	7,762	246,873	3.14
Pasay	3,818	127,629	2.99
Valenzuela	4,376	193,025	2.27
Pasig	4,205	212,895	1.98
San Juan	624	31,519	1.98
Las Pinas	2,907	156,899	1.85
Quezon City	12,238	738,724	1.66
Mandaluyong	1,726	116,954	1.48
Marikina	1,419	104,415	1.36
Makati	2,437	186,381	1.31
Muntinlupa	1,813	138,331	1.31
Paranaque	1,633	182,216	0.9

[a]Listahanan - Number of Poor Household from Department of Social Welfare and Development (DSWD) 2020.
[b]Number of Household by City and Municipality from Philippine Statistics Authority (PSA) as of 01 May 2020

The city of Manila is the country's center for economic, political, social, and cultural activities. However, further validation on the livelihood zones was not employed for the city due to the unavailability of its CLUP and other related land use data. Malabon City, on the other hand, is largely dominated by Services and Commercial zones, with limited agricultural areas devoted for fishing activities. Lastly, Caloocan City is primarily an area for residential, and concentration of employment is more on logistics and transportation due to its strategic location.

These cities are also largely dominated by Services zones and any disruptions on livelihood and activities in these areas may exacerbate the existing conditions of poor households. Based from the study of Rufino (2013), a typical poor household in NCR considers food, house rent, and utilities as major expenditure items and necessities. The current living conditions in urban areas, however, makes it difficult for households to meet these basic needs, all the more during the event of flooding, typhoon, or any climate-related hazard.

The Department of Social Welfare and Development (DSWD) implements the *Pantawid Pamilyang Pilipino Program (4Ps)* as the flagship social protection program of the government through conditional cash transfer (CCT). It was launched in 2008 and as of 2020, NCR has a total of 214,051 household beneficiaries (DWSD, 2020)[12]. Among the determinants to qualify for the 4Ps program include conditionalities on health, education, and family development sessions. According to Bayundan-Dacuycuy and Baje (2017)[13], the 4Ps only strengthens human capital and self-sufficiency but does not explicitly address the risks associated with climate change impacts. Hence, they propose the inclusion of environment protection through tree planting, beach reforestation, and solid waste management as an additional condition to 4Ps. This, in turn, will serve as an adaptive social protection which can support climate change adaptation and disaster risk reduction and management.

[12] https://transparency.dswd.gov.ph/wp-content/uploads/2020/09/Major-Programs-and-Projects-Beneficiaries-2020.pdf
[13] https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps1725.pdf

4. Implications on Food Security

As discussed in the previous section, major direct impacts of climate-related hazards on built-up areas are the loss of income and disruption on the supply chain. These impacts have huge implications to food security since these affect the capacity of individuals to access and purchase food. According to FAO (2006), food availability, accessibility, utilization, and stability must be ensured at all times, especially during economic or climatic crisis, to promote food security.

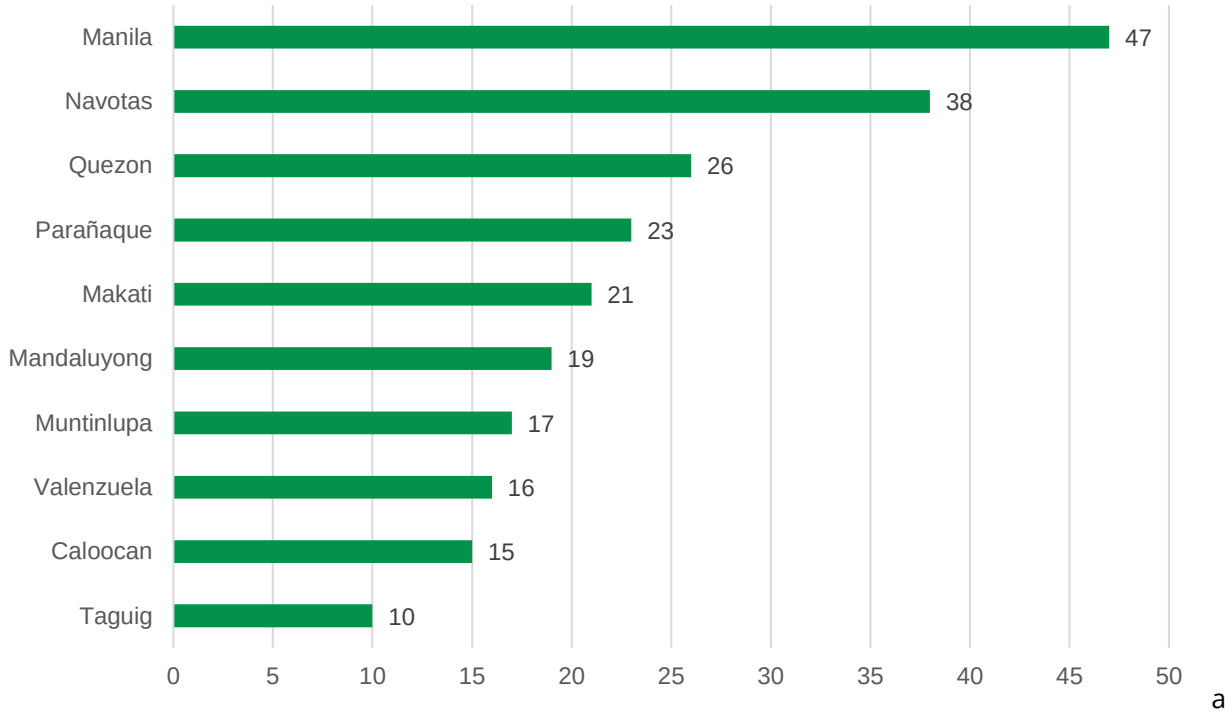
In terms of food availability, disruptions on the food supply chain may lead to insufficient quantity and inappropriate quality of food available in the market. Consequently, the reduction in business activity, increased under/unemployment, and reduction in income due to the impacts of climate-related hazards will affect food accessibility in built-up areas. Movement restrictions due to the disruption in transportation systems make it difficult for individuals to access food, especially to poor households which heavily rely on retail markets for their daily food consumption. Disorganized transportation and socio-economic systems will also induce higher commodity prices, thus, also affecting affordability of available food. These conditions force households to resort in coping mechanisms which can eventually affect their food security. For instance, a study of WFP as cited by Israel and Briones (2013)[14] showed that 94% of the households surveyed in NCR relied on eating less preferred food due to the impacts of Typhoons Ondoy (Ketsana) and Paeng (Parma) that hit the Philippines in 2009. Based on the study, other coping strategies commonly practiced by the households surveyed were borrowing food from friends/neighbors, buying food on credit, and reducing meals by adults. In terms of food utilization, these coping strategies have significant impact on food security since households do not have adequate food which can meet their physiological needs.

Moreover, according to the Pan American Health Organization (PAHO, n.d.)[15], "the nature of food and nutrition problems depends on the type of disaster, its duration, size of the area affected, and the nutritional status of the population prior to the disaster". In NCR, data presented in Figure 10 shows that the cities of Manila, Navotas, Quezon, Parañaque, Makati, Mandaluyong, Muntinlupa, Valenzuela, Caloocan, and Taguig had the highest number of deaths related to malnutrition in 2020. On the other hand, Figure 11 shows the prevalence of Severe and Moderate Acute Malnutrition (S/MAM) among children ages 0-59 months in the region in 2021.

The graphs show that the city of Navotas consistently ranked among the areas with the highest prevalence of malnutrition cases in NCR. Navotas City also ranked as highly susceptible to flooding, sea level rise, and storm surge as shown in the previous sections. Given that it also has majority of the agriculture zone in NCR, disruptions on the livelihood activities in the city may further exacerbate problems related to health and nutrition, and ultimately food security, not only in Navotas but in the whole NCR as well.

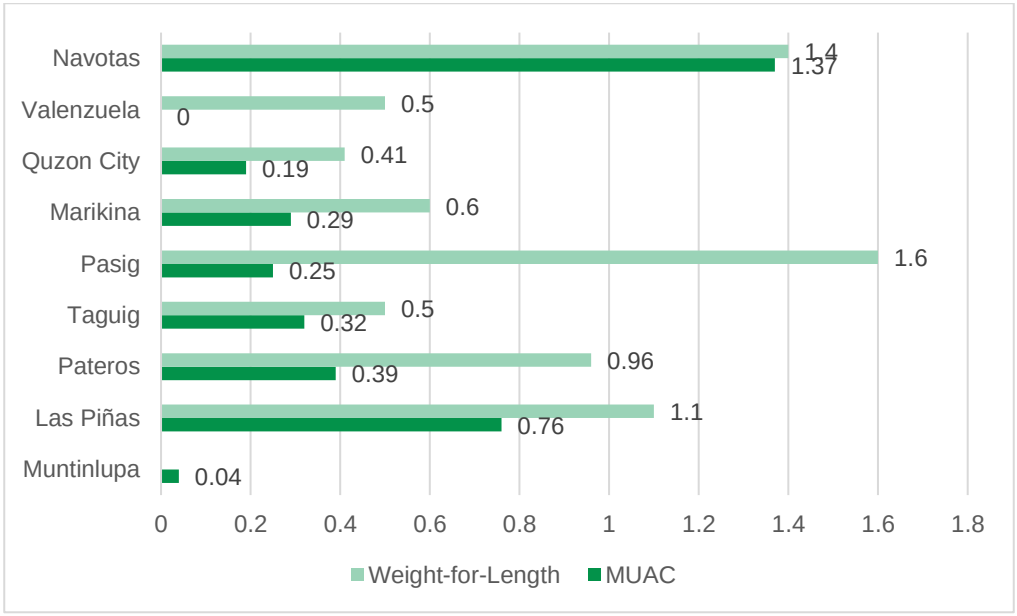
[14] https://www.eria.org/ERIA-DP-2013-15.pdf
[15] https://www.paho.org/en/health-emergencies/food-and-nutrition-disasters

Figure 10. Number of deaths by malnutrition in NCR (2020)
Source: Statista (2023)[16]



a

Figure 11. Prevalence of severe and acute malnutrition among children (0-59 months) in NCR in 2021
Source: National Nutrition Council (2021)[17]



[16] https://www.statista.com/statistics/1120609/malnutrition-cases-national-capital-region-by-city-philippines/
[17] https://www.nnc.gov.ph/phocadownloadpap/userupload/Roncr-webpub1/2022%20OPT%20Plus%20Results%20with%20Analysis_NCR_FINAL.pdf

Agricultural commodities produced in rural areas are the main source of food inputs in urban areas including NCR.

In the study of Barrameda (2017)[18], it was emphasized that the practice of urban agriculture, particularly home gardening, has been already existent in several areas in NCR such as Quezon City. As shown in Figures 10 and 11, Quezon City also has high prevalence of malnutrition, hence, its government had initiated programs which can reduce poverty and improve the nutrition of its residents. Following the implementation of the "Joy of Urban Farming" program in 2010 by then Vice Mayor Joy Belmonte, several households, public elementary schools, day care centers, and parishes have already practiced urban agriculture (Yap, n.d. as cited in Barrameda, 2013). According to Barrameda (2013), some of the home gardening strategies practiced by households include: "1) container gardening which makes use of repurposed styrofoam, fruits crates and all unused containers; 2) vertical gardening in which plants in containers are mounted on either walls or fences; and 3) maximizing water use by collecting and saving rainwater".

With the potential of urban agriculture to address food insecurity in NCR, Local Government Units (LGUs) are urged to support households in building their own home gardens. Aside from supplying agricultural inputs, LGUs need to provide technical assistance and support to improve the knowledge and skills of urban residents in implementing and sustaining home gardens.

[18] https://cswcd.upd.edu.ph/wp-content/uploads/2021/10/PJSD-Vol-9-2017_Barrameda.pdf

5. Summary and Conclusion

This report highlights the research findings of the CCFSA in NCR. Specific livelihoods in built-up areas within the region were characterized and the areas and population that are most susceptible to climate change were identified.

The LHZ map of NCR and its corresponding datasets were validated and refined as necessary. Based on the analysis, four (4) built-up area subclasses are present in the region, namely: Services, Commercial, Manufacturing/Industry, and Agriculture.

The livelihood profile of NCR shows that it is dominated by Services zones with some Agriculture zones located in the cities of Navotas, Mandaluyong, and Caloocan which are mainly devoted for fishery-related activities. On the other hand, the analysis of climate-related hazards showed that NCR is generally moderately susceptible to flooding, storm surge, and sea level rise. The municipality of Pateros and the city of Navotas, however, were found to be highly susceptible to these climate-related hazards.

For built-up areas such as NCR, climate change has direct and indirect effects. Direct impacts are physical damages on infrastructure, loss of livelihood and income, and disruption on the supply chain due to failure of transportation systems. Indirectly, all of these may lead to economic losses which may induce higher prices of basic goods and services.

These impacts take a greater toll on poor households since they are more exposed and have greater risks from climate-related hazards. The temporary or permanent loss of livelihood and income also have huge implications on food security since it affects people's capacity to purchase and access affordable and nutritious food.

While the percentage of poor households in NCR is relatively low, the existing conditions of residents in the region may worsen given that climate change impacts are projected to strengthen and continue if urbanization and population growth continue to rise. The LHZ map, together with other relevant databases, can serve as a tool to conduct a highly localized analysis of the impacts of climate change on specific livelihood groups which can support the development of appropriate adaptation strategies.

6. References

Ballesteros, Marife M.; Domingo, Sonny N. (2015). Building Philippine SMEs Resilience to Natural Disasters, *PIDS Discussion Paper Series, No. 2015-20.* Philippine Institute for Development Studies (PIDS), Makati City, Philippines.

Barrameda, T. (2017). Surviving in the City Through Home Gardens: A Case Study of Home Gardeners in Barangay UP Campus. *Philippine Journal of Social Development, 9,* 39–69.

Bayudan-Dacuycuy, C., & Baje, L. K. (2017). Chronic Food Poverty in the Philippines. In *https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps1725.pdf.* Philippine Institute for Development Studies. Quezon City, Philippines.

DSWD. (2020). Major Programmes/Projects - Pantawid Pamilyang Pilipino Program. In *https://transparency.dswd.gov.ph/wp-content/uploads/2020/09/Major-Programs-and-Projects-Beneficiaries-2020.pdf.* Department of Social Welfare and Development. Quezon City, Philippines.

Israel, D., & Briones, R. (2013). Impact of Natural Disasters on Agriculture, Food Security, and *Natural Resources and Environment in the Philippines.* Economic Research Institute for ASEAN and East Asia. Jakarta, Indonesia.

Keller, L. (2013, May 7). *Impact of Sea Level Rise in the Philippines: Charting Climate Change in Metropolitan Manila.* https://sites.tufts.edu/gis/files/2013/11/Keller_Lauren.pdf.

Lapidez, J. P., Tablazon, J., Dasallas, L., Gonzalo, L. A., Cabacaba, K. M., Ramos, M. M. A., Suarez, J. K., Santiago, J., Lagmay, A. M. F., & Malano, V. (2015). Identification of storm surge vulnerable areas in the Philippines through the simulation of Typhoon Haiyan-induced storm surge levels over historical storm tracks. *Natural Hazards and Earth System Sciences, 15(7),* 1473–1481. https://doi.org/10.5194/nhess-15-1473-2015

PAHO/WHO. (2019, December 10). *Food and Nutrition in Disasters.* Pan American Health Organization. https://www.paho.org/en/health-emergencies/food-and-nutrition-disasters.

Partners for Resilience. (2018). *Fact Sheet: Navotas City.* https://rilhub.org/wp-content/uploads/2020/07/Factsheet_Navotas-City_TLMv_2201811_compressed.pdf.

Pornasdoro, K., et.al. (2014). Flood Risk of Metro Manila Barangays: A GIS Based Risk Assessment Using Multi-Criteria Techniques. *Journal in Urban and Regional Planning,* 51–72.

Singh, G. & Gadgil, G. (2017). *Navigating Informality: Perils and Prospects in Metro Manila's Slums.* World Bank. Washington DC.

Subingsubing, K. (2023, August 19). *Sea level rise in PH capital exceeds global norm — Namria | Inquirer News.* INQUIRER.net. https://newsinfo.inquirer.net/1818597/sea-level-rise-in-ph-capital-exceeds-global-norm-namria

WB. (2003). *Poverty and climate change: Reducing the vulnerability of the poor through adaptation.* (2003). World Bank.

ANNEX 1. Total gainful workers 15 years old and over (PSA, 2018)

DISTRICT	Municipality	Armed Forces Occupations Both sexes	Clerical Support Workers Both sexes	Craft and Related Trades Workers Both sexes	Elementary Occupations Both sexes	Managers Both sexes	Not Reported Both sexes	Other Occupation Not Elsewhere Classified Both sexes	Plant and Machine Operators and Assemblers Both sexes	Professionals Both sexes	Service and Sales Workers Both sexes	Skilled Agricultural Forestry and Fishery Workers Both sexes	Technicians and Associate Professionals Both sexes
NCR, CITY OF MANILA, FIRST DISTRICT (Not a Province)	CITY OF MANILA	914	107491	55661	134354	76966	3226	121	66917	66930	190449	2014	40908
NCR, SECOND DISTRICT (Not a Province)	CITY OF PASIG	277	60125	31819	48881	33924	1088	8	33351	36198	63812	743	25847
NCR, THIRD DISTRICT (Not a Province)	CITY OF CALOOCAN	330	73428	97205	109059	51613	928	0	87246	52088	142253	2785	41498
NCR, FOURTH DISTRICT (Not a Province)	CITY OF LAS PIÑAS	257	35409	25278	37959	24440	488	9	26063	28559	54501	913	22637
NCR, FOURTH DISTRICT (Not a Province)	CITY OF MAKATI	2124	53868	16922	38770	34526	1275	3	22324	40574	51949	518	25086
NCR, THIRD DISTRICT (Not a Province)	CITY OF MALABON	66	14925	21084	29332	12515	147	0	18855	10528	33519	1603	10221
NCR, SECOND DISTRICT (Not a Province)	CITY OF MANDALUYONG	121	31884	14509	23884	17435	814	9	15408	22717	34060	403	15920
NCR, SECOND DISTRICT (Not a Province)	CITY OF MARIKINA	145	31980	20628	27667	19611	545	6	17954	20557	36730	668	15993
NCR, FOURTH DISTRICT (Not a Province)	CITY OF MUNTINLUPA	203	25996	24059	31471	18652	2031	0	22210	18534	48135	1397	24322
NCR, THIRD DISTRICT (Not a Province)	CITY OF NAVOTAS	17	8656	13025	22700	7378	148	0	10736	5445	24146	7793	4430
NCR, FOURTH DISTRICT (Not a Province)	CITY OF PARAÑAQUE	279	39811	27422	51396	32077	2587	0	28899	30768	67588	1181	28560
NCR, SECOND DISTRICT (Not a Province)	CITY OF SAN JUAN	44	9442	3594	9723	7658	1338	0	4121	6548	12537	119	3256
NCR, THIRD DISTRICT (Not a Province)	CITY OF VALENZUELA	62	30771	37650	49108	19587	253	0	49290	18790	48756	1048	15221
NCR, FOURTH DISTRICT (Not a Province)	PASAY CITY	1366	32212	14499	28477	16760	593	0	16086	15247	58972	391	8985
NCR, FOURTH DISTRICT (Not a Province)	PATEROS	12	4484	2768	3547	2663	79	0	3115	2667	5377	67	2625
NCR, SECOND DISTRICT (Not a Province)	QUEZON CITY	2354	173543	129669	224239	132719	13554	0	123077	125779	272680	4080	94736

ANNEX 2. Gainful workers groupings by sector

AGRICULTURE	SERVICES	MANUFACTURING AND INDUSTRY	INFORMAL
Skilled Agricultural Forestry and Fishery Workers	Armed Forces Occupations	Craft and Related Trades Workers	Not Reported
	Clerical Support Workers	Plant and Machine Operators and Assemblers	Other Occupation Not Elsewhere Classified
	Elementary Occupations	Technicians and Associate Professionals	
	Managers		
	Professionals		
	Service and Sales Workers		

ANNEX 3. List of LHZ subclasses in the National Capital Region

Row Labels	Sum of Percent Area
Caloocan City	**100**
Built-up Areas - Agriculture	**24.74**
Green Buffer	24.74
Built-up Areas - Commercial	**16.35**
Commercial	12.87
Planned Unit Development	3.48
Built-up Areas - Manufacturing and Industry	**15.53**
Industrial	15.53
Built-up Areas - Services	**43.37**
Cemetery	1.08
Residential	36.18
Socialized Housing	6.11
City of Las Pinas	**100**
Built-up Areas - Agriculture	**0.54**
Parks and Open Space	0.54
Built-up Areas - Commercial	**21.18**
Commercial	11.37
Planned Unit Development	9.81
Built-up Areas - Manufacturing and Industry	**2.59**
Industrial	2.59
Built-up Areas - Services	**75.69**
Residential	75.69
City of Makati	**100**
Built-up Areas - Agriculture	**4.58**
Parks and Open Space	4.58
Built-up Areas - Commercial	**36.51**
Commercial	36.51
Built-up Areas - Manufacturing and Industry	**2.48**

Row Labels	Sum of Percent Area
Industrial	2.48
Built-up Areas - Services	**56.44**
Institutional	2.69
Residential	53.75
City of Malabon	**100**
Built-up Areas - Agriculture	**2.69**
Parks and Open Space	2.69
Built-up Areas - Commercial	**17.18**
Commercial	17.18
Built-up Areas - Manufacturing and Industry	**25.27**
Industrial	25.27
Built-up Areas - Services	**54.86**
Institutional	0.30
Residential	54.56
City of Mandaluyong	**100**
Built-up Areas - Agriculture	**10.24**
Parks and Open Space	10.24
Built-up Areas - Commercial	**28.06**
Commercial	28.06
Built-up Areas - Services	**61.7**
Institutional	1.62
Residential	60.08
City of Marikina	**100.00**
Built-up Areas - Commercial	**18.25**
Commercial	18.25
Built-up Areas - Manufacturing and Industry	**9.12**
Industrial	9.12
Built-up Areas - Services	**72.63**
Residential	72.63
City of Muntinlupa	**100.00**
Built-up Areas - Agriculture	**4.06**
Parks and Open Space	4.06
Built-up Areas - Commercial	**25.95**
Commercial	15.85
Planned Unit Development	10.10
Built-up Areas - Manufacturing and Industry	**0.90**
Industrial	0.90
Built-up Areas - Services	**69.09**
Cemetery	1.55
Residential	65.83
Socialized Housing	1.13
Utilities	0.58
City of Navotas	**100.00**
Built-up Areas - Agriculture	**35.24**
River	35.24
Built-up Areas - Commercial	**27.50**
Commercial	27.50
Built-up Areas - Manufacturing and Industry	**18.29**
Industrial	18.29

Row Labels	Sum of Percent Area
Built-up Areas - Services	**18.97**
Institutional	0.39
Residential	18.58
City of Paranaque	**100.00**
Built-up Areas - Commercial	**35.56**
Commercial	25.29
Planned Unit Development	10.27
Built-up Areas - Manufacturing and Industry	**1.81**
Industrial	1.81
Built-up Areas - Services	**62.63**
Cemetery	2.80
Institutional	0.13
Residential	53.67
Utilities	6.03
City of Pasig	**100.00**
Built-up Areas - Commercial	**22.48**
Commercial	14.21
Planned Unit Development	8.27
Built-up Areas - Manufacturing and Industry	**14.04**
Industrial	14.04
Built-up Areas - Services	**63.48**
Institutional	1.13
Residential	62.35
City of San Juan	**100.00**
No Data Available	**100.00**
No data Available	100.00
City of Valenzuela	**100.00**
Built-up Areas - Agriculture	**5.56**
Fishpond	5.56
Built-up Areas - Commercial	**14.84**
Commercial	14.84
Built-up Areas - Manufacturing and Industry	**28.88**
Industrial	28.88
Built-up Areas - Services	**50.72**
Cemetery	0.98
Institutional	0.16
Residential	49.58
Pasay City	**100.00**
Built-up Areas - Commercial	**40.40**
Commercial	40.40
Built-up Areas - Services	**59.60**
Institutional	8.16
Residential	21.02
Utilities	30.42
Quezon City	**100.00**
Built-up Areas - Commercial	**24.76**
Commercial	8.58
Planned Unit Development	16.18
Built-up Areas - Manufacturing and Industry	**8.16**

Row Labels	Sum of Percent Area
Industrial	8.16
Built-up Areas - Services	**67.08**
Institutional	6.23
Residential	60.85
Binondo	**100.00**
No data available	100.00
Ermita	**100.00**
No data available	100.00
Intramuros	**100.00**
No data available	100.00
Malate	**100.00**
No data available	100.00
Paco	**100.00**
No data available	100.00
Pandacan	**100.00**
No data available	100.00
Pateros	**100.00**
No data available	100.00
Port Area	**100.00**
Utilities	100.00
Quiapo	**100.00**
No data available	100.00
Sampaloc	**100.00**
No data available	100.00
San Miguel	**100.00**
No data available	100.00
San Nicolas	**100.00**
No data available	100.00
Santa Ana	**100.00**
No data available	100.00
Santa Cruz	**100.00**
No data available	100.00
Taguig City	**100.00**
No data available	100.00
Tondo I / II	**100.00**
No data available	100.00

World Food Programme
11th floor, South Tower, Rockwell Business Center Sheridan, corner Sheridan and United Streets, Mandaluyong City, 1554, Philippines | Telephone +632 8-833-6229 | Email: wfp.philippines@wfp.org
wfp.org

Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT)
c/o UPLBFI Bldg. Andres P. Aglibut Ave., Los Baños, Laguna, 4031 Philippines
https://alliancebioversityciat.org