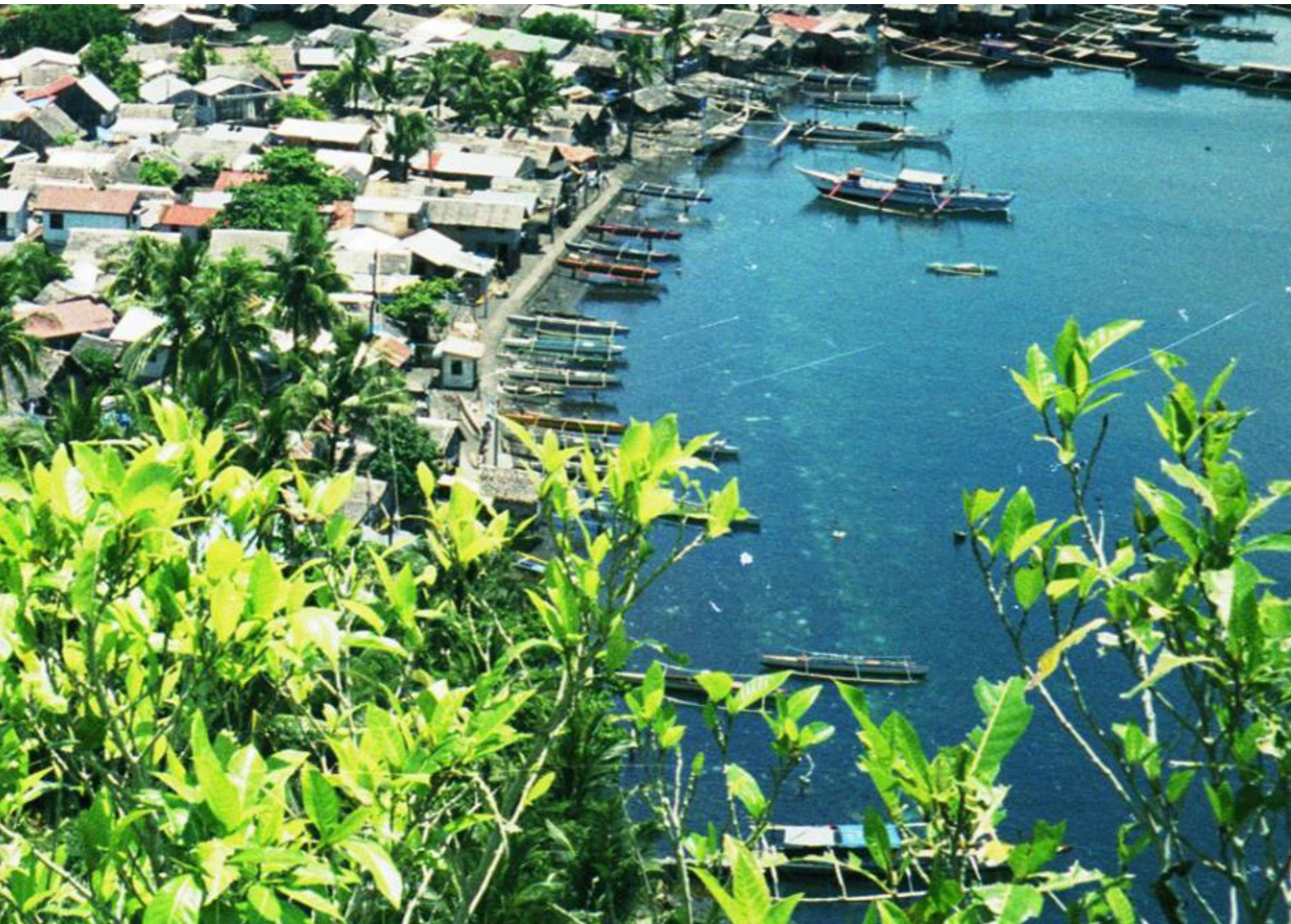
LEGAZPI CITY

CASE STUDY ON THE PATH TO CLIMATE RESILIENCY



ABOUT OUR CITY

Legazp City, the capital city of Albay province, serves as the Bicol Region's hub for government services, education, tourism, and transportation. Aside from its inter-regional connection to growth centers such as Metro Cebu and Metro Manila, Legazpi City also serves as the gateway to surrounding provinces such as Sorsogon, Catanduanes, Masbate, Camarines Norte, and Camarines Sur. The Luzon Spatial Development Framework 2015-2045 and the Bicol Regional Development Plan 2017-2022 envision Legazpi City and Naga City as metropolitan centers that will anchor the urban growth of the Bicol Region. The Metro Legazpi Development Corridor (Legazpi-Daraga) will function as the regional government center and transportation hub servicing the provinces of Albay, Sorsogon, Catanduanes, and Masbate. With the establishment of an international airport in the adjacent Municipality of Daraga and the revival of the Philippine National Railways, the city is expected to attract tertiary industries, tourism-based investments and enterprises, and new migrants. Based on the Philippine Statistics Authority 2015 census, the city's population is estimated at 196,639.[1] It is projected that by 2028, Legazpi City's population will increase to 237,412.[2]

With a total land area of 16,165.05 hectares, the city is composed of 70 *barangays* (villages), 45 of which are classified as urban and the other 25 as rural. In terms of area size, total urban area is 2,628.57 hectares or 16.26% of the total land area of the city. However, 53% of whole city population resides in this urban space, which also caters to an additional 30% of the total population who either work or study in the urban center during daytime. Urban sprawl is evident in the northern and southern portions of the city, which are mostly rural residential areas mixed with agriculture and light industrial areas. The contiguous urban zones are concentrated in the central coastal, low-lying flat areas of the territory where the Central Business District, residential spaces, regional government offices, schools, and transportation facilities are located.

The city's urbanization context is a diverse ecosystem. Legazpi City has areas classified as forest land, which accounts to 15.84% (or 1,729 hectares) of the city's total land area.[3] The forest land encompasses seven *barangays*: Mabinit, Bonga, Matanag, Padang, Cagbacong, San Francisco, and Buenavista. Water resources like springs and water tributaries, which have the potential to become a potable water source for

[1] Philippines Statistics Administration. 2015. Albay Province 2015 Census. http://rsso05.psa.gov.ph/sites/default/files/Albay.xls.
[2] Legazpi City Government. 2019. Comprehensive Land Use Plan 2019-2028, p. 26.
[3] Department of Environment and Natural Resources. 2015. 2015 Land Classification.

areas south of the city, are found in Barangay Buenavista. Currently, these water sources supply low-lying communities of the *barangay* and will need significant investments if it will be distributed to the urban center. The forest areas are a likewise critical resource for the irrigation of agricultural lands, whichincludes 1,372 hectares of rice farms 2,542 households depend on for their income.

The city is also endowed with coastal and marine ecosystems making fishing a major livelihood for the people of Legazpi. It also has 26.92 hectares of mangrove areas, and the total municipal waters span 8,478 hectares. The coastal ecosystem supports the primary source of income of 3,825 registered fisherfolks. Of the total 70 *barangays* (villages) of the city, 17 are are located in the coastal zone, 9 of which are classified as urban areas.

Legazpi City was awarded as the Most Competititive Component City in 2018 based on the Cities and Municipalities Competitiveness Index, which is annually organized by the Department of Trade and Industry. In 2019, the city ranked 4th overall in the same component cities category. These recognitions for the city were due to the high scores it received on the following categories:Infrastructure, Government Efficiency, Resiliency, and Economic Dynamism.

The city's economy is dominated by tertiary level industries in the commercial sector. The city experiencees unprecedented commercial sector growth based on records of the City Business Licensing Office. From 2012-2017, the number of business establishments in the city has increased by 174% (estimated increase of 200 new commercial establishments per year). This increase, plus the continued public and private infrastructure investments, has been providing livelihood and job opportunities for the people that ultimately pushes the city's socio-economic development.

The local government is working to sustain its economic growth and attain the city's vision of becoming the international gateway to Luzon and Visayas offering world class tourism-related facilities and services.

Also part of Legazpi City's targets is complementing its progressive growth with technology-driven and suatainable solutions. Since the city is located along the eastern seaboard and typhoon belt, it is susceptible to the impacts of typhoons from the Pacific Ocean. Historically, these have triggered floods, storm surges, severe winds, rain-induced landslides, and lahar flows. Thus, achieving climate and disaster resilience is crucial for it to attain its envisioned growth.

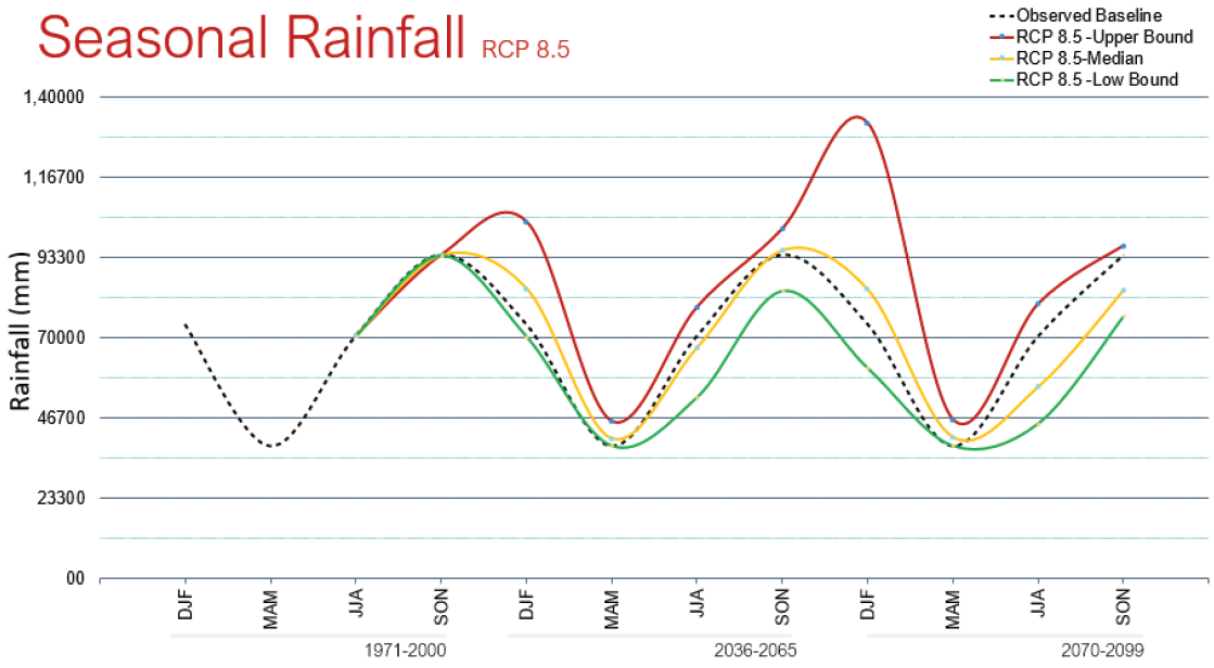
Previous disaster events and the changing climate scenario is compelling the city to continue its knowledge building for the implementation of transformative climate actions to help ensure that its people, economic growth, and environmental resources would remain competitive and sustainable while urbanization continues to rapidly unfold in the city.

Our People in the Face of Climate Change

The national government, through The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), provided the needed climate information that the city requires in order to plan and adapt to potential climate change impacts. PAGASA data reveals that it is plausible for the rainfall volume in Legazpi City to decrease under the low and median bound Representative Concentration Pathway (RCP) 8.5 projection (Figure 1). However, for high-bound scenario of the same projection, it is also likely for the rainfall volume during December to February to have an additional increase of 297.9 millimeter (mm) 2036-2065 and 585.2 mm in 2070-2099. These could be 40% to 79% increase from the current observed rainfall volume.

It is observed that the trend for mean temperature for Legazpi City is increasing. Projections of PAGASA show that there will be

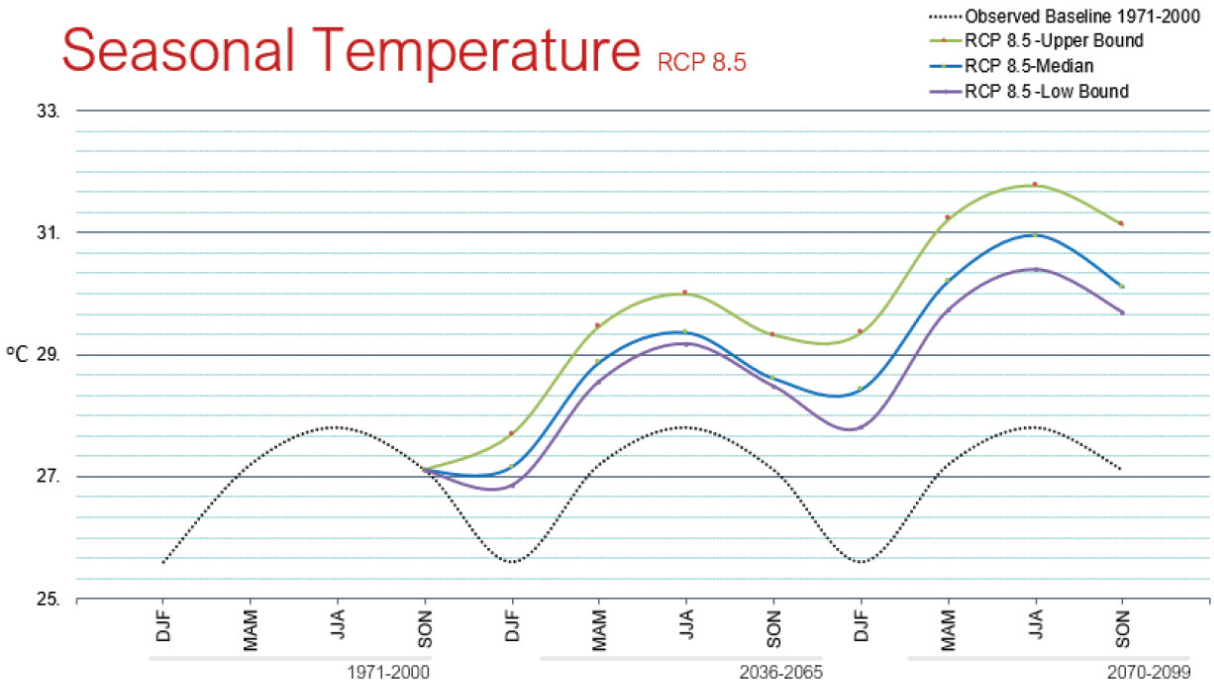
Figure 1: Representative Concentration Pathway 8.5 (Seasonal Rainfall Projections)



DJF = December, January, February; MAM = March, April, May; JJA = June, July, August; SON = September, October, November; mm= millimeter; RCP = Representative Concertation Pathway.

Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration.

Figure 2: Representative Concentration Pathway 8.5 (Seasonal Temperature Projections)



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Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration.

an increase in mean temperatures by as much as 2.2OC by year 2036 and 3.9OC by the end century. Presented by season, the temperature projections show that it will be hottest during June, July, and August (Figure 2). Apart from typhoons, which could bring storm surges, other extreme events are also projected to be a threat to the city. Extreme rainfall could trigger disastrous flooding and lahar flows. Moreover, low elevation areas, especially those below sea level, are facing risks from tidal floods and inundation from projected sea-level rise.

All the above climate trends and climate-related hazards are expected to challenge the sustainable development of the city—threatening its people, economy, and natural resources. To prepare for the anticipated challenges, the City Government,utilized the Climate and Disaster Risk Assessment (CDRA) tool issued by the national government for the development of its Local Climate Change Action Plan (LCCAP) formulation. The LCCAP process, which was supported by the Vertical Integration and Learning for Low-Emission Development (V-LED) project of the United Nations Human Settlements Programme (UN-Habitat), allowed evidence-based decision making. The process helped the city government to systematically generate crucial planning information, particularly on climate risks that affect the exposed population, land use, natural production areas, critical infrastructure, and lifeline utilities in the city.

From the CDRA and LCCAP process, the city government identified various decision areas[4] based on the levels of risks, including the underlying contributing factors. The city government validated that an estimated 60,710 individuals are highly at risk to floods, storm surges, and sea-level rise. These individuals mostly reside in riversides, low-lying flood plains, and coastal areas, and they currently represent approximately one-third of the total population of the city. Further investigation shows that of the total at-risk population, around 21% are informal settlers, 30% are living in housing units made from light to salvageable materials, and 49% are living below the poverty threshold. When these families are affected, as in previous disasters, the coping mechanism is to redirect household income for repairs and rehabilitation, further reducing their purchasing power for basic household needs and pushing them to extreme poverty. Moreover, the local government may be compelled to redirect public investments for financial aid and rehabilitation, which can consequently delay the implementation of crucial sectoral development programmes.

The projected decrease in seasonal rainfall could threaten water security in the city as it may affect the availability of water from surface run-off. Potable water supply in the city comes from harnessing the underground and surface sources. Decreasing rainfall also puts the natural ecosystem in the city at risk, which may limit the ecosystem services it provides to people. Climate impacts on natural ecosystems could affect the livelihoods of 169 forest resource-dependent individuals and 1,392 fisherfolks. Assessments also revealed that 2,542 rice farming dependent-households are at risk from the changing rainfall volumes. When rice farmers are unable to cope with climate change, the rice sufficiency rate of the city, currently estimated at only 30.76%, could further decrease and impact on the people's food security.

The urban ecosystem that performs a critical role in the city's socio-economic growth is likewise presented with climate risks: 43 hectares of Legazpi City's commercial areas vulnerable to floods, 61 hectares are exposed to storm surges, 28 hectares susceptible to sea-level rise, and 21 hectares are prone to lahar flows. The risk levels of the exposed areas range from moderate to low. Areas with low levels of risk could be attributed to: the resilient design employed by commercial building owners; high capacity to retrofit buildings, and access to insurance. However, potential damages to building contents and the duration to implement repairs after climate extreme events typically result in prolonged disruption of commercial services. The disruption significantly poses a negative effect on the local economy as it results in lower profits of businesses, loss of employment earnings for households, lower government revenue collection rates, and redirection of government funds intended for priority sectoral development programmes and projects.

Approximately 41 hectares of vital regional government- and education-related institutional areas in Barangay Rawis are moderately at risk to storm surges where potential wave heights may exceed 1.5 meters. The increasing frequency of extreme rainfall events may trigger lahar flows, which may affect 7.46 hectares of institutional areas within the Yawa River mouth areas. These areas were assessed as high risk to lahar flows mainly due to a lack of

[4] Identified high to moderate risk areas triggered by climate extremes and projected climate change variables.

proper resilient building design. These hazards may significantly disrupt essential government services, delay vital developmental processes in the region, and trigger the government to redirect funds for building repairs and rehabilitation.

The Rawis - San Joaquin - Dita - Pawa - Bogtong Road/Bogtong Pawa Bridge and DM Jct-Legazpi-Sto Domingo-Tabaco Road/Yawa Bridge were assessed to be highly at risk to lahar flows. These roads and bridges serve as vital linkage systems connecting the urban center to the northern *barangays*, and Legazpi City to other cities and municipalities along the Albay Gulf. A disruption of these vital linkage may isolate northern *barangays*; delay of response and relief operations and flow of goods; and limit access of rural areas to socio-economic support services located in urban areas.

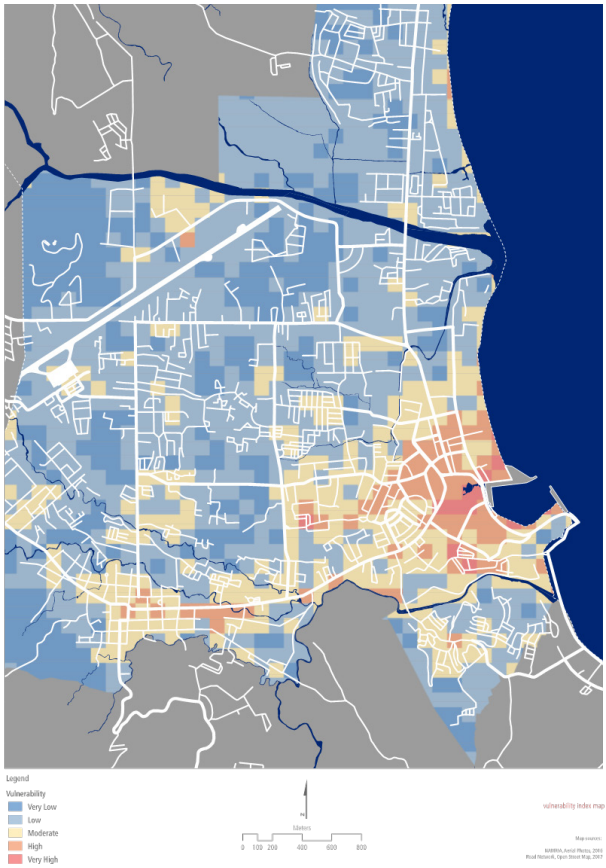
Springs and wells on the slopes of Mayon Volcano are the main source of water supply of the Legazpi City Water District (LCWD). To augment supply during peak hours, the LCWD sources water from the Yawa River. Potable water is distributed via pipelines to the urban area and two important water distribution pipes transect the Yawa River, which were assessed as high risk to lahar flows. It is unknown whether these distribution pipes are resilient enough to withstand the potentially damaging effects of large magnitude lahar flows. The prolonged submergence of pipes to floodwater may also affect water quality. Disruption of water services may threaten domestic water supply in the urban areas. Prolonged water service disruptions due to extremes triggered by climate change will have detrimental impacts on the health of the residents and operations of commercial establishments.

With a potential increase in accumulative annual rainfall using the Representative Concentration Pathway (RCP) 8.5 high bound projection[5], the city government is exploring strategies to encourage residential and non-residential water consumers to take advantage of the projected increase in annual rainfall amount. Considering the city's population growth, rate of urbanization, and potable water demand, harnessing rainfall will bring in long-term benefits and help augment existing piped water supply.

The increasing temperature due to climate change will create impacts on households and business alike. For instance, areas in the Port Area Central Business District and Old Albay district are highly vulnerable to urban heat stressdue to its highly built-up characteristic, lack of tree cover, and limited open spaces. There is also not enoughurban greening along roads. These roads, especially east-west oriented roads, absorb heat during the daytime and emit the stored heat during nighttime.

At the household level, increasing temperatures will also mean increased power consumption for cooling and increased demand for motorized transportation due to hot, unsuitable pedestrian walkways. Vulnerable individuals—young and old, and those with heat-related illness—are presented with high risk from temperature increase given the urban heat stress experienced in the city (Figure 3).

Figure 3: Urban Heat Stress Mapping



Source: Local Climate Change Action Plan 2019-2028, City Government of Legazpi.

[5] Representative Concentration Pathway (RCP) 8.5 is the highest emission scenario leading to a radiative forcing of 8.5 W/m2 at the end of the century. High bound refers to the wettest plausible scenario for seasonal rainfall.

Based on anecdotal observations, hot ambient room temperatures, especially from June to August, make classrooms not conducive for teaching and learning. There is a growing concern if school buildings can accommodate the projected increase in temperatures due to climate change and its impact on indoor temperatures. Apart from classrooms, the same indoor temperature conditions are observed in government offices where workers are dependent on air conditioning to make rooms conducive for office work.

Increased dependence on airconditioning systems may consequently lead to increased GHG emissions. Through the LCCAP process, the city also conducted an inventory of its GHG emissions with 2017 data as the base year.

The initial results from the inventory revealed that the activities in the city generated around 108,300 tonnes of greenhouse gas (GHG) in 2017[3] . The major contributor to GHG emissions is purchased electricity that is 79% of the total. Agriculture crop areas have a 9% share, and mobile combustion contributes 7% to the total gross GHG emissions.

The inventory also identified the existing carbon sinks of the city. The sinks are composed of forests, mangroves, and grasslands that totals approximately 807 hectares or 4.9% of Legazpi's total land area. Based on date, the sinks can only sequester an estimated 4,700 tonnes or 4.33% of the annual emissions recorded for the base year. It could be gleaned from the GHG inventory that there is a wide gap between the GHG emissions and sequestration capacity in the city.

At business as usual development, the city anticipates a further increase in GHG emissions over the next 10 years as it plans to pursue an agri-ecotourism and commercial development thrust. The proposed additional 300 hectares of commercial and residential land use will result in additional GHG emissions overtime. The Philippines, as signatory to the Paris Agreement, has committeed to pursue national actions to address climate change through both adaptation and mitigation, although the latter as of 2019 is all conditional to the extent of financial resources, including technology development and transfer and capacity building, that will be made available to the Philippines.

While the national commitment is conditional, the city government will try to initiate a 61% reduction of its GHG emissions by 2028. This will be achieved by instituting policies and strategies to reduce the electricity consumption of buildings; investing and encouraging in green transportation and non-motorized mobility; and increasing its GHG sink capacity. Legazpi City's commitment to mitigate emissions come from the understanding that the mitigation actions are going to likewise build people's resilience to climate impacts (e.g., temperature and heat risk management) and are good investments for the cities sustainable and green development.

Our Pursuit to Build Resilience through Urban Plans and Designs

As Legazpi City values the importance of partnership in its pursuit for sustainable development, the city government has been working with UN-Habitat Philippines and the Housing Land Use Regulatory Board for the Building Climate Resiliency since 2017 through Urban Plans and Designs (BCRUPD) project. According to the city's Technical Working Group (TWG) organized for the project, climate-resilient urban planning and design is a relatively new concept and topic for the city. The project capacity needs assessment reveals that there is a low level of awareness on urban design approaches in the context of climate change adaptation and sustainable development as there are limited to no trainings at all on the topic for city technical personnel. Also, the assessment revealed that members of the TWG have average competencies on climate financing, geographic information system, multi-hazard vulnerability and risk assessment, urban policy and strategy development, and climate-resilient urban design.

These average capacities reflect on Legazpi City's 2013 Disaster Risk Reduction and Management-Climate Change Adaptation and Mitigation (DRRM-CCAM Plan), which contains data gaps on ecosystem and sectoral impacts of climate change and indicators to measure risks, vulnerabilities which can guide local policy and allow the city to pursue systematic disaster risk reducation (DRR) and CCAM. The plan also does not present climate trends and projections and mainly focuses on sudden onset hazards and have yet to fully assess potential impacts of seasonal seasonal changes in temperature and rainfall.

Upon reviewing the 2009-2018 Comprehensive Land Use Plan (CLUP) and Zoning Ordinance, the Local Government Unit (LGU) recognized the need to further develop local capacities to better understand the implications of climate change to medium- and long-term spatial development planning and determine the necessary policies and strategies to address emerging challenges and opportunities.

Through BCRUPD project, the city government had the opportunity to improve its capacity to adapt to climate change through the promotion of climate-responsive and sustainable urban development plans and designs. The Local Climate Change Action Plan (LCCAP) enhancement was the entry point of the project. The formulation process helped the TWG members to increase their knowledge and understanding of climate change, especially all the plausible climate scenarios they will encounter in the future. The ecosystem-based approach also helped them better appreciate how the projected climate scenarios may impact various elements across different ecosystems and how these ecosystems are closely linked. Through the process, the concerned LGU staff also learned to anticipate future implications of the city's current urban development strategy and its long-term climate resilience aspirations. With the improved risk assessment process introduced during the course of the project, the city government now has an improved understanding of the concept of risk and recognized that reducing the level of risk can be done by addressing exposure, vulnerabilities, and adaptive capacities.

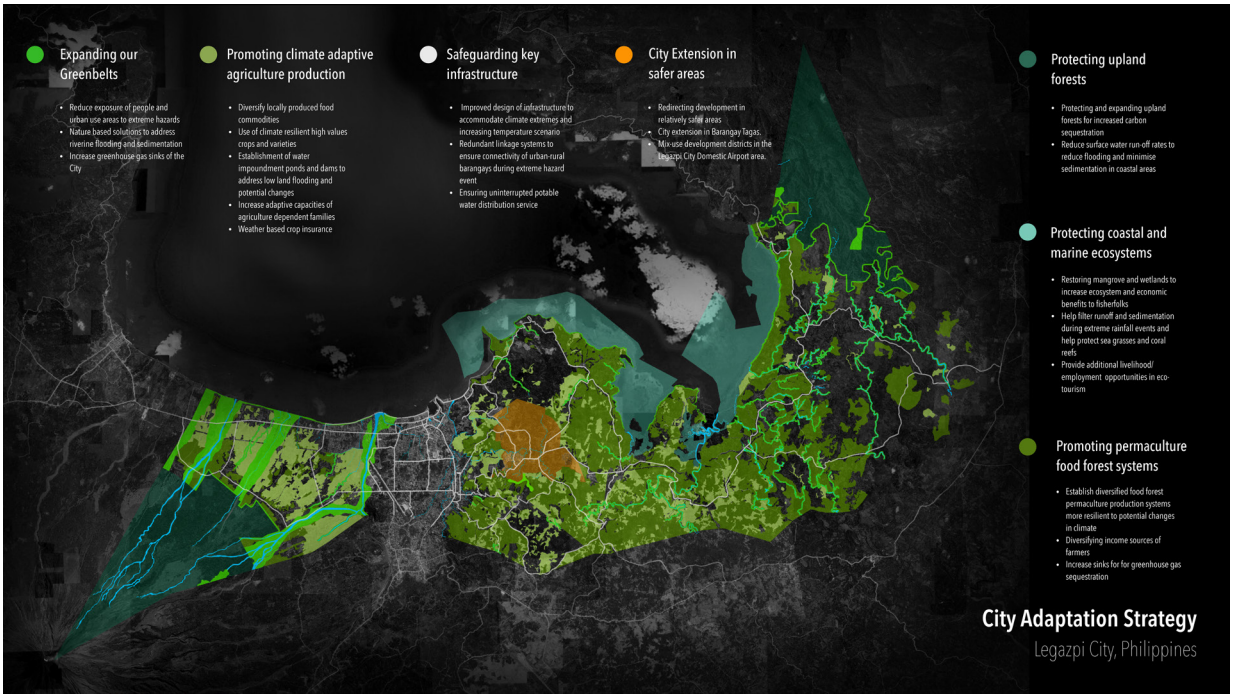
[6] Legazpi City. 2019. Local Climate Change Action Plan 2019-2028 pp. 123-133.

Enhancing the City's Climate Adaptation Strategy and Overall Climate Action Plan

With new information derived from the CDRA and GHG inventory, and relating these findings with the city's CLUP and Comprehensive Development Plan (CDP), the TWG analyzed the different climate issues and opportunities the city is facing. The adaptation strategies and policy framework as well as its climate adaptation goals, objectives, and targets were developed and are now contained in the city's enhanced LCCAP.

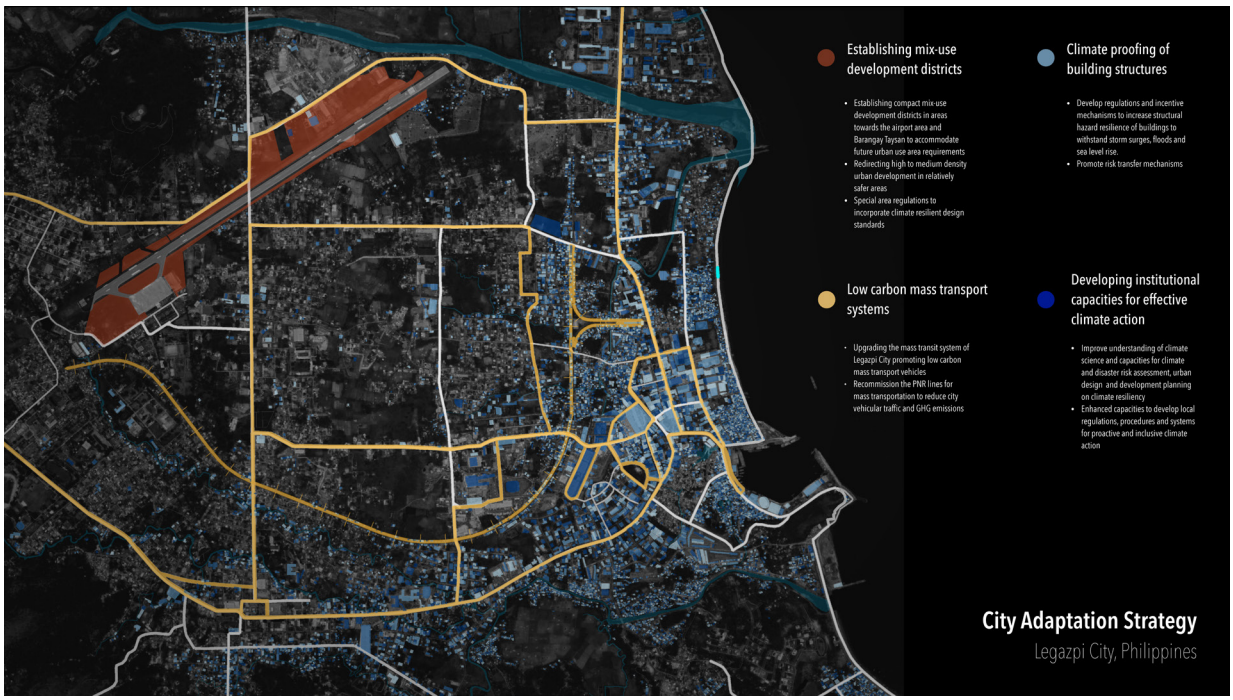
The city adaptation strategy (Figures 4 and 5) and policy framework was formulated through consultation workshops with partner agencies, which include the Department of Human Settlements and Urban Development (DHSUD) and local chapters of the United Architects of the Philippines and Philippine Institute of Environmental Planners. ARCADIS-Philippines, a consultancy firm for natural and built assets, presented their urban design recommendations as well. The strategy and framework is a testament to the city's improved understanding of the urban design strategies and approaches to climate change adaptation, humanizing climate issues, and application of ecosystem-based approaches for resilient plans and design. . A paradigm shift towards alternative green solutions rather than merely relying to infrastructure-based interventions while also a stronger campaign to emphasize the co-benefits for both climate and sustainable city development from proposed interventions.

Figure 4: City Scale Adaptation Strategies



Source: City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

Figure 5: City Adaptation Strategies in Urban Areas



Source: City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

Inspired by learnings from technical inputs and workshops on the cumulative risks associated with sea level rise, storm surges, lahar flows, and floods affecting institutional, commercial, and residential areas in the coastal areas, the city is leading its new urban growth areas in relatively safer places such as the Uptown Legazpi District in Barangay Taysan and a mix-use district in the domestic airport area, while maintaining its strategic advantages as an urban growth center in the region. These areas will serve as alternative sites for the regional government center, and accommodate future land requirements for commercial, residential, and education- and government-related institutional areas. This change in urban structure supports institutional resilience, which was one of the identified objectives of the city. It is expected to increase climate resilience of the economic sector to floods and storm surges and reduced population risks associated with floods, storm surges, and lahar.

Addressing Flooding and Lahar through Urban Planning and Design

To ensure the connectivity of the urban and northern *barangays* during lahar and flood events and safeguarding the potable water supply and distribution systems, the Legazpi City is establishing redundant north-urban linkage and distribution systems. This involves building additional bridges transecting Yawa River and ensuring infrastructure design can withstand expected hazard intensities. Also, new potable water sources in the southern portions of the city will be explored and will serve as an alternative source of potable water as the city expands towards the south. This strategy also anticipates the potential supply interruptions since the current primary water source and distribution systems are concentrated in the northern parts of the city susceptible to lahar flow and floods.

To increase the resilience of coastal and marine resources-dependent families, areas with coastal and marine ecosystems will be part of the city's non-invasive eco-tourism sites. This strategy hopes to provide alternative livelihood opportunities, prioritizing the most vulnerable families. To increase the resilience of farming and inland fisheries-dependent households, the city will promote and support climate-resilient agriculture production, including the establishment of water impoundment ponds and dams to address low land flooding and and ensure continuous water supply.

To reduce the flooding in the urban center and future damages and disruptions to business establishments, the city government recommended urban designs such increasing the permeability of the landscape to allow rainwater to soak in the landscape by using permeable surface materials; establishing dual purpose parks capable of detaining and delaying water; putting up water impoundment facilities in adjacent agricultural areas within the Macabalo river basin; redesigning drainage to temporarily delay water surface flow and increase recharge of ground water; and exploring additional design standards for the construction of rainwater harvesting systems, where the capacity is relative to the non-permeable surfaces of the property and rainfall levels.The city government also recommended to treat creek and riversides as property frontages to provide better justification of expanding river and creek easements and setbacks to prevent future encroachment along riverbanks and accommodate future pedestrian access systems.

The ridge to reef concept and its applications to land use planning was also applied in the Taysan City extension area. The LGU recognized that the business as usual urban design[7], if applied in the Taysan City extension area, will only increase surface water flow rates, which may affect flood patterns in the in low-lying areas. Sponge city approaches such as rain water harvesting of structures, unpaved surfaces, tree cover, urban swales, and river side linear park were some of the proposals being explored to be applied in the Taysan City Extension District to ensure that the planned urban expansion does not affect low-lying areas of the Macabalo River Basin. The LGU also saw the need to increase the rain water absorptive capacity of the proposed land uses in upper areas of the Macabalo River Basin, which includes developing peripheral agriculture areas as food forest systems and encourage the establishment of agriculture water impoundments that can also serve as fresh water fish production. Also, the city government realized the need to interface these strategies with the Municipality Daraga which is part of a common river basin boundary.

To increase the adaptive capacities of 1,940 individuals along the Macabalo and Sagumayon Rivers, the city government recommended to transform creek and riverside areas as new urban development corridors. This can be done through urban design adjustments such as changing the land use mix from purely residential to mixed use zones to provide additional economic opportunities; allowing private sector participation in upgrading business operations to support the formal economy and securing loans that will allow them to setup viable businesses;

and increasing financial capacities to build or retrofit their building to accommodate flood hazards. Incorporating additional open spaces that can function as flood management facilities to reduce flood levels affecting property owners was recommended as well. In the development of the creek and riverside corridors, the city realized that fine-tuning zoning regulations such as minimum lot sizes, floor area ratio, maximum allowed percentage of site occupancy (MAPSO), and imposing unique building code regulations covering structural resilience design, firewalls and property fences can be further reviewed.

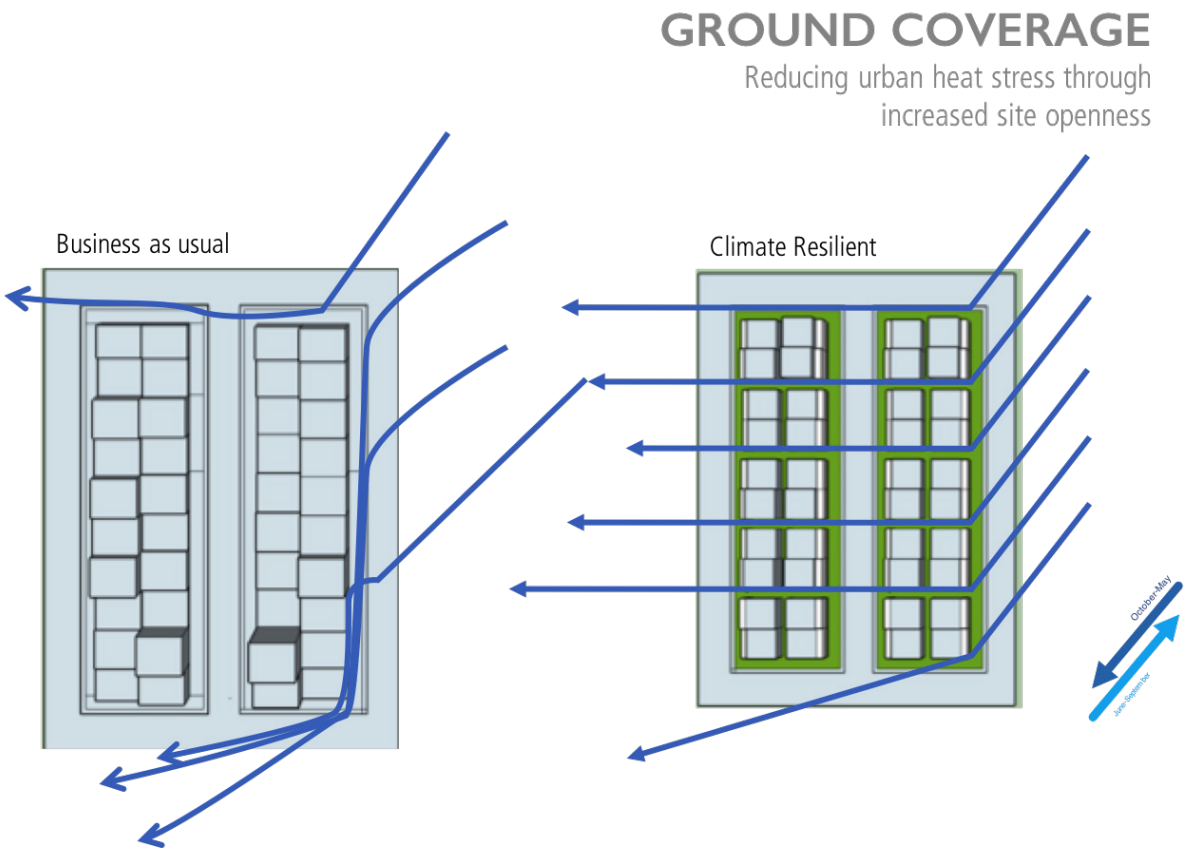
Although no specific regulations were included in the zoning ordinance, the intention of these recommendations are to ensure the safety and lives of the people, ensure buildings are structurally capable of withstanding floods, reducing potential damages to building contents and prevent future subdivision of lots into smaller plots to allow future flexibility for interventions and other regulations. Also, road orientation should be predominantly perpendicular to the creek and riversides and/or provide perpendicular human access systems to facilitate emergency evacuation.

Using Urban Planning and Design to Address Urban Heat Stress

Through the CDRA, the city managed to determine potential areas susceptible to urban heat stress and targeted the reduction of urban area temperatures. The LGU also recognized that further planned expansion of its urban areas using the business as usual approach (e.g., designs that do not consider wind flow) will only further contribute to the future warming of the urban center, mindful of the projected increasing seasonal temperatures. To prepare for this, the city recommended appropriate urban design approaches, including building height and orientation relative to the sun path to provide ground level shading; increasing site openness (Figure 6); adjusting to the floor area ratio and MAPSO; and maximizing roads and parks and open spaces as breezeways that provide ground level airflow, wind tunneling, and passive cooling effect of the prevailing wind flow patterns of the city. Design recommendation on tree cover or green building facades, and solar reflectance regulations of buildings and roofs will supplement the mentioned urban design approaches. The city is also looking into augmenting tree cover along streetscapes and parks, using solar reflective materials and/or materials with a lower thermal mass to reduce heat absorption.. These recommendations can also contribute to reduced GHG emissions by lowering electricity consumption and encouraging non-motorized mobility. However, the city is still in the process of translating these into detailed statutory regulations subject to consultations with stakeholders and will influence future iterations of the CLUP, and Zoning Ordinance, and related ordinances.

[7] The business as usual design approach is characterized by heavy use of concrete materials and absence of hybridization with natural elements (e.g., trees, grass, vegetation).

Figure 6: Proposed Adjustments to Ground Coverage for Reducing Urban Heat Stress through Site Openness



Source: City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

While there is already a Philippine National Green Building Code (Presidential Decree 1096), the city recognized limitations in its coverage. The said building code applies to the construction or alteration of buildings that are 10,000 square meters (sqm) and above and majority of the buildings in the city are below 10,000 sqm.

The city is planning to implement its local green building code to regulate the retrofitting of structures and guide the construction of new buildings. This is in parallel with capacity development of local personnel engaged in the review and approval of building permits. With new learnings on urban design principles and approaches, this should allow the TWG and relevant decision makers to elevate the discussions when deliberating certain urban design provisions of the local green building code to promote resource efficiency and climate change adaptability of the buildings in the city. Furthermore, city recommended to develop incentive mechanisms for proponents implementing green building interventions and renewable energy generation systems through the local investment and incentives code and local revenue code to further promote the low emission development strategy of the city.

Translation and visualization of proposed designs (see Figure 7) can be better illustrated to LGU using available computer rendering software such as SketchUp and Lumion. In the case of Legazpi, the local United Architects of the Philippines Chapter provided free assistance to the TWG in visualizing policies and strategies for streetscapes. The coty government also engaged the academe, particularly Bicol University and the University of the Santo Tomas, to participate in urban design workshops with the hope that key learnings will influence their respective research agenda and increase research on climate-resilient urban planning and design in the region.

Figure 7: Visualization of Greening Interventions Along Streetscapes

Source: United Architects of the Philippines, Legazpi City Chapter, City Government of Legazpi, and UN-Habitat Philippines.

Legazpi's Plans to Lower Greenhouse Gas Emissions

To reduce GHG business as usual emissions by 61%[8], the city recommended increasing greenhouse gas sinks though the expansion of green belts, buffer zones, restoration of riparian forests, and the rehabilitation, conservation and protection of existing upland and mangrove forests. Also, mono-cropped coconut areas will be diversified into food forest systems which can produce additional key food commodities, with the added benefit of sequestering greenhouse gases.

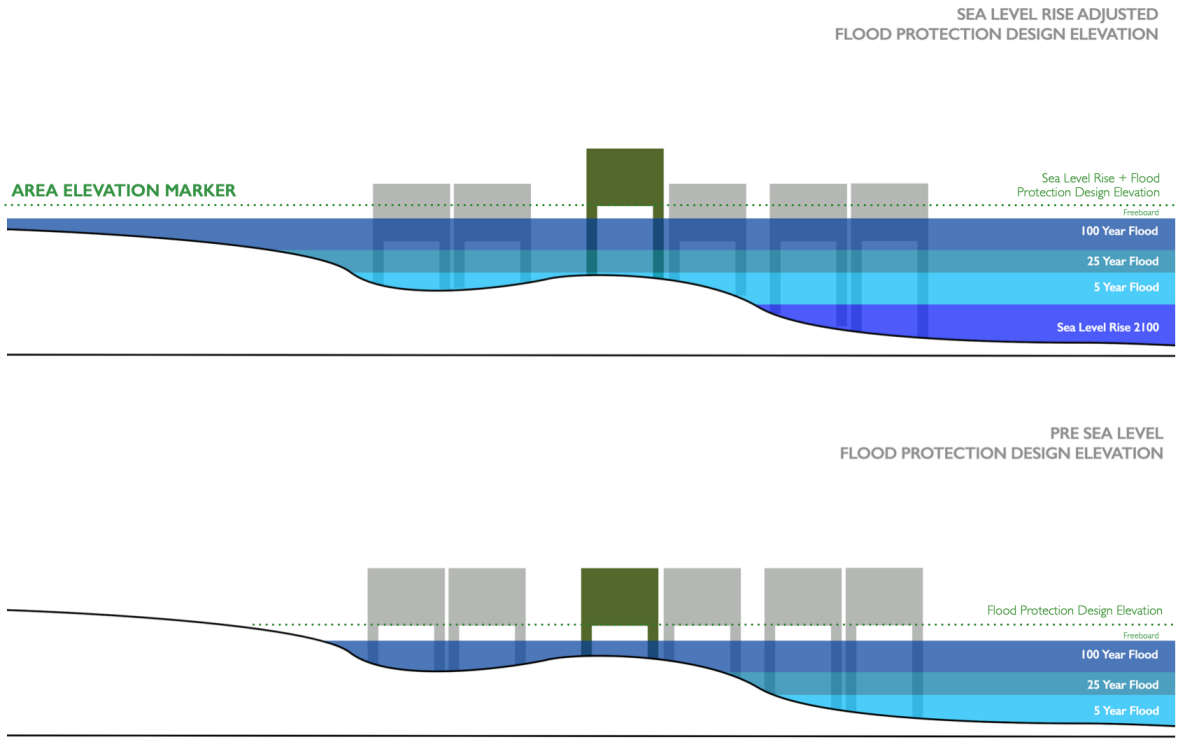
The city also sees the opportunity to modernize the mass transport system by using alternative hybrid buses, jeepneys, tricycles and explore reviving the Philippine National Railroad lines that will connect Legazpi City and Daraga. It also recognized that need to redesign its streetscapes and opening new pedestrian networks to encourage non-motorized mobility to further reduce GHG emissions levels of the transportation sector.

[8] Legazpi City Government. 2019.Local Climate Change Action Plan 2019-2028, pp.131.

Using Urban Planning and Design to Adapt to Sea-Level Rise

Based on sea-level rise (SLR) projections, sea levels will increase by approximately 1.1 meter by the end century, affecting 79 hectares of urban use areas mostly commercial and residential. The city also recognizes the potential effect of rising sea levels to flood patterns along coastal and low lying areas. To increase the resilience of buildings to combined impacts of SLR and floods, the city recommended conducting further hydrological studies. Results of the study will inform possible adaptation pathways covering SLR areas and guide future land use decisions in succeeding iterations of the CLUP and Zoning Ordinance. It will also help the city determine area elevation markers, which will serve as basis for future statutory regulations such as the flood protection and SLR design elevation (Figure 8) to facilitate retrofitting of existing structures and guide future building design and infrastructure systems to withstand the combined impacts of floods and sea level rise. Recognizing the limited information available, the LGU adopted a cautious approach by initially expanding the urban coastal easement, establishment of greenbelts and public open spaces andparks to prevent future exposure of built areas.

Figure 8: Proposed Sea-Level Rise Design Elevation



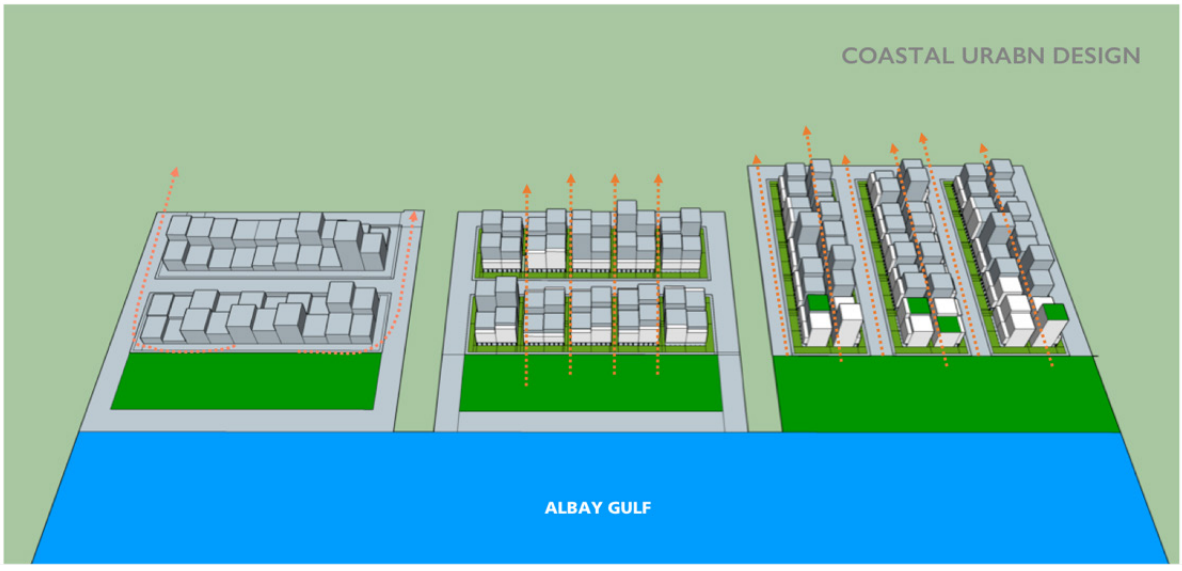
Source: City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

One of the objectives of LCCAP is to increase the adaptive capacities of 7,310 affected individuals. Recommendations include provision of livelihood opportunities, job placement and priority in terms of local employment, and increased participation of vulnerable groups to small and medium scale enterprises. Also, the city is exploring various options such as retaining and re-development of sea level rise potentially affected areas by

redesigning building structures that can adjust to changes in sea levels and accommodate climate extremes such as storm surges and tsunami, and providing spaces for inclusive tourism. It should be noted, however, that the area is prone to storm surges, floods, liquefaction, and tsunami. Thesaid areas used to be part of the wetland and mangrove areas as well. Thus, the city governments needs to carefully consider if onsite redevelopment is feasible. Another option being considered is the development of socialized and subsidized tenement housing areas in a suitable site within the urban center. This socialized housing concept will provide housing and incorporate commercial spaces for employment and opportunities for leasing commercial spaces to potential locators to augment and subsidize housing loans of potential beneficiaries.

To increase the resilience of buildings and people to storm surges, the city is recommending orienting roads or access systems perpendicular to the coast (Figure 9) to facilitate emergency evacuation; formulatingresilient building design standards relative to the expected storm surge wave height which will be based on future storm surge modelling; and expanding coastal setback requirements to accommodate coastal parks as natural protection to storm surges as an alternative to the traditional infrastructure solutions such as sea walls. Another recommendation is to promote property insurance instruments to provide post disaster economic protection or relief to potentially affected property owners. The identified urban design recommendations also contribute in addressing urban heat stress by channeling winds emanating from the coast towards the Central Business District, especially during the Amihan season.

Figure 9: Urban Design Recommendations Along Coastal Areas



- Streets oriented parallel to coast
- Coastal easements converted into roads
- People lose relationship with the coast because of improperly designed coastal road infrastructure
- Buildings built without side setbacks restricts wind flow
- Pedestrian access limited by the lack of side setbacks

- Streets oriented parallel to coast
- Coastal easements converted into roads
- People lose relationship with the coast because of improperly designed coastal road infrastructure
- Buildings built with side setbacks allowing wind flow
- Pedestrians can walk through setbacks during evacuation
- Frontages can be renatured for additional protection from storm surges

- Streets oriented perpendicular to coast
- Coastal easements remain at its natural state
- Buildings with frontages and rear setbacks allow wind to flow
- Roads facilitates evacuation away from the coastal easements and frontages can be renatured for additional protection from storm surges

Source: City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

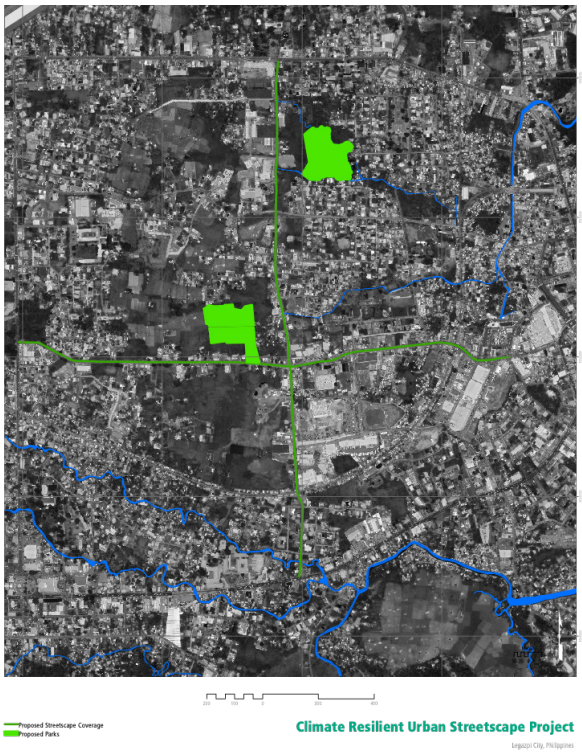
Piloting Climate-Resilient UPD through Urban Streetscape Project

The multi-criteria decision tool recommended by the BCRUPD project facilitated the selection of the urban design project. Based on the project prioritization workshop, the TWG applied a mix of criteria or considerations, which includeed: stakeholder acceptability, technical feasibility, urgency, effectiveness, mainstreaming potential, and multi-stakeholder relevance. The TWG received technical guidance to assess three priority projects: the Yawa River Edible Forest Park, Climate-Resilient Urban Streetscape (CRUS), and the North-South Don Miguel Lopez de Legazpi Boulevard Coastal Linear Park. Proposed projects were assessed depending on technical feasibility, multi-sectoral relevance, stakeholder acceptability, and relative cost.

In hindsight, an additional criterion can be included: the number of potential beneficiaries, specifically targeting the most vulnerable individuals or groups. Other small community-scale projects targeting the most vulnerable groups could have been shortlisted to cover areas at risk to both sea-level rise and floods.

The CRUS project (Figure 10) was eventually selected due its relevance; potential to address both urban heat stress and floods; potential to contribute to the city's GHG emissions reduction targets; and replicability in other urban streetcapes of the city. Through the pilot demonstration project, the city government also saw the opportunity to assess the attitude and acceptance of the residents of the shared responsibility approach in addressing climate issues since the chosen project involves property rights of landowners.

Figure 10: Site Boundary Map, Climate-Resilient Urban Streetscape Project



Source:City Government of Legazpi and UN-Habitat Philippines. 2019. Building Climate Resiliency through Urban Plans and Designs Project.

Thriving—and Not Merely Surviving—in the Face of Climate Change

With better understanding of its climate-related issues and opportunities, the city government realized that it could stir its local development in a better pathway towards a more resilient future for its people. As Legazpi City pursues an agri-ecotourism and commercial development thrust, the city government further qualifies that it should be achieved through a low emission development strategy and one that is climate-smart and resilient.[9] Climate change and its potential impacts greatly influenced government policies, medium and long term spatial and development plans, and spatial regulations through the zoning ordinance.

The city government also realized that urban design elements could be included in statutory instruments to facilitate the climate adaptation process. Among the urban design elements which were already included in the zoning ordinance are the use of the solar reflectance index in the design of buildings[10]; providing zoning incentives for proponents implementing climate change adaptation and DRRM technologies or innovations (i.e., use of solar panels, rainwater harvesting, smart urban drainage systems, green architecture or building systems)[11]; expanding setbacks along major rivers[12], implementing vertical garden requirements relative to the concrete surface area of buildings orstructures along major roads and urban corridors; encouraging open parking spaces to use unpaved surfaces and incorporate tree cover to contribute in addressing urban flooding and minimize site temperatures[13]; transforming the Central Business District into a pedestrian-friendly area with urban shading and proper observance setbacks; and using sustainable drainage systems to include rainwater storage tanks green roofs that can decrease the flow and make productive use of storm water run-off for areas within the Tourism Circuit Overlay and Flood Overlay Zones.[14] The city also sees the need to craft urban design guides to implement these recommendations and strategies. Furthermore, additional local legislation is being crafted specifically the local green building code, and the local investment and incentive code that would contain regulations and provide an incentive mechanism to facilitate the adoption of climate-resilient urban design among residents and business establishments.

Legazpi City demonstrated a paradigm shift in addressing climate risks by emphasizing "no regrets", nature-based and integrated solutions.[15] The city government realized that these alternative strategies can be more economical and sustainable in the long term compared to conventional infrastructure-based risk management approaches such as coastal storm surge protection nature coastal parks, hybrid flood management parks, and lahar greenbelt nature and tourism parks. Also, it realized that current road network designs (i.e., designs with minimum area required, no integrated plan for connectivity and walkability, and an absence of greeneries and permeable design) only contribute to the further heating of the city and that streetscapes can be further enhanced using urban design approaches such as incorporating natural elements and alternative materials to influence pedestrian behavior, minimize electricity costs towards a low emission future.

While climate change brings negative impacts to the city, the local government also sees other potential benefits that can be explored and maximed for local development. The realization that the city might experience changes in seasonal rainfall triggered win-win interventions,

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[9] City Government of Legazpi City, Comprehensive Land Use Plan 2019-2028, pp 108, 118.
[10] Legazpi City Zoning Ordinance 2019, p. 38
[11] Ibid, p.20
[12] Ibid, p.25
[13] Ibid, p.9
[14] Ibid, p. 15, 19
[15] "Low or no regret" measures are climate change measures whose direct benefits are not easily quantifiable and/or not immediate but has co-benefits that are significant enough to justify implementation (Source: Climate Change and National Urban Policies in Asia and the Pacific. 2018)

such as the establishment of water impounding systems to provide water to agricultural areas and also serve as flood management interventions especially in agricultural areas sharing the same river basin boundary with the urban center. Also, to adapt to all plausible rainfall scenarios and extreme rainfall events, the city is promoting the harvesting of rain water and increasing ground permeability in urban areas to augment potable water supplies and recharge groundwater, as well as reduce surface flow volumes to contribute in addressing floods. With better flood modelling information, the city is reviewing the rain-water harvesting ordinance to provide clear design regulations pertaining to the required capacity of the rain water storage that they will impose to significantly address urban flooding and reduce flood levels in low-lying coastal river and creek areas.

The inclusive and climate-resilient economic strategy, which the city is pursuing, offers long term social benefits as it will increase the adaptive capacities of vulnerable families. The strategy will also promote a culture of self-reliance in dealing with climate challenges. The city considered these climate issues and came up with adaptation strategies such as providing economic and employment opportunities by opening up new commercial development corridors to benefit the informal sector; giving technical and infrastructure support to augment incomes of farming-dependent families; and opening new eco-tourism development areas to provide alternative sources of income to forest and coastal and marine resource-dependent communities. The proposed strategies aim to uplift the social well-being of the residents by increasing heir purchasing power. This is crucial for them to cope with the future challenges of climate change.

The city government considers housing as a fundamental right and contributes significantly to increased adaptive capacities of at risk families. Embedded in the Comprehensive Development Plan (CDP) is the provision of decent, resilient, and quality homes for the most vulnerable groups or severely affected population by 2028. The CDP stresses the need to identify and develop 200 hectares of land suitable for housing and resettlement. The city is now looking at innovative solutions to the housing backlog such as socialized-subsidized tenement housing schemes. Such schemes will allow the city government to combine housing and commercial spaces, helping defray the high cost of purchasing lands in urban areas. This also allows flexibility in choosing sites relative to the workplace of the target beneficiaries and provide loan subsidies helping ensure affordability. Anticipating the future climate scenario, the city also hopes to apply resilient urban design by incorporating resource-efficient and climate-resilient design principles.

Since majority of the proposed solutions to address the climate change impacts are beyond the current financial and technical capacities of the city government, private-public partnerships are being explored for interventions on capacity and capability development. Some of the identified LCCAP projects have already been incorporated in the medium-term investment plan of the city subject to availability of funds and commitment from the private sector and potential donors. The LGU is also rolling out capacity building activities on preparing project proposals to secure climate financing for the city. In preparing future project proposals, the city government will strive to uphold social and environmental safeguards, while quantifying social, economic, and environmental costs and benefits.

To sustain its local climate action, the city sees the importance of further building its local capacities on climate science, climate and disaster risk assessment, urban design, structural hazard resilient design, project proposals preparation, and mainstreaming these into their participatory planning and decision-making processes. This will also allow them to inject urban design elements, especially for projects initiated by regional and national government agencies.

Investing in resilience means protecting the economy, the community, and the people. The city government is committed to transform Legazpi into a resilient and thriving city and welcomes assistance from potential partners and funders to realize this vision.

About the BCRUPD Project

Building Climate Resiliency Through Urban Plans and Designs (BCRUPD) is a three-year German-government-funded project being implemented by the United Nations Human Settlements Program (UN-Habitat) in partnership with the Department of Human Settlements and Urban Development (DHSUD), and other Philippine government agencies in five cities.

It aims to support the Philippine government in improving policies, regulations, and capacities to adapt to climate change through the promotion of climate-responsive sustainable urban development plans and designs. In support of existing national climate change frameworks and strategies, it aims to enhance national and subnational government representatives' institutional capacities to guide and manage urban growth towards suitable areas and design the same incorporating resilience principles and practices.

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