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Planning 3:

Introduction to Urban and Regional Planning

A Research Paper on

Redesigning Bato, Catanduanes

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BACKGROUND OF THE STUDY

Bato is situated along the eastern coast of the Bicol Region and lies in the southeastern part of the storm-tossed island Province of Catanduanes. It is located (11) kilometers southeast of Virac, the provincial capital town. It is bounded on the north by the Municipality of San Miguel; on the east by the greatest body of water, the Pacific Ocean; on the South by Cabugao Bay and on the West by the Municipality of Virac. Meridional coordinates of the municipality's location are 124015'16" to 124i21'7" East longitude and 13 32'50" to 130 38'47" North latitude.

Bato is one of the satellite municipalities of the Province of Catanduanes. It is a fifth class municipality composed of 27 barangays with a total land of 4,880 hectares, which is the smallest among the 11 towns of the province. It is a 20-minute ride from Virac, the provincial capital passing through a paved national road.

Agriculture and fishing are the major industries. The best variety of abaca fiber (Manila hemp) is produced in Bato. It is also the only municipality in the province that produces millet, a kind of cereal that is one of the town's delicacies.

The geographical location of Bato, facing the Pacific Ocean was found to be a "Tuna Highway" Large and marketable sizes of tuna are caught the whole year round as well as other first-class fish species like blue marlin and tanguigue.

Being in the middle of the country's typhoon belt, Virac (and the rest of Catanduanes) has no pronounced dry season; rather, it has about 12-15 rainy days a month on average. There is a greater chance of rainfall and typhoons between October to February. The decreasing forest cover has continued despite the logging ban that was imposed by the national government in the province' forest lands in 1973, which was exacerbated by unsustainable upland farming practices and other land uses. Thus, resulting in low soil productivity, soil erosion, loss of biodiversity, and impaired hydrology, which when allowed to continue, would threaten the province' supply of water and pose serious repercussions to the lowland ecosystem and to the people's wellbeing. These forest areas are the main source of all types of water supply in the province for domestic, irrigation, industrial, hydro-electric power generation, recreation, and others.

STATEMENT OF THE PROBLEM

Since Bato, Catanduanes is located within the typhoon belt, it is highly vulnerable to natural calamities and damages brought about by floods and typhoons. Due to the recent Typhoon Rolly and Typhoon Ulysses, Bato experienced severe flooding throughout the city as

most houses were found near water. With that, most structures, if not all, were left in extremely poor conditions. In addition, Bato is also found to be abundant in natural features that could serve as tourist attractions. The project entails to redesign the city in terms of resiliency towards natural disasters and economic growth conforming to sustainable development goals (SDG) for zero hunger, clean water, sustainable cities and communities.

PROJECT OBJECTIVES

1. To redesign Bato, Catanduanes in order for it to become more resilient to natural disasters through the use of proper urban planning.
2. To be able to provide enough resources to sustain the livelihood of the residents and tourists of Bato, Catanduanes by maintaining the natural resources and making a good economic profit from it.

SITE ANALYSIS

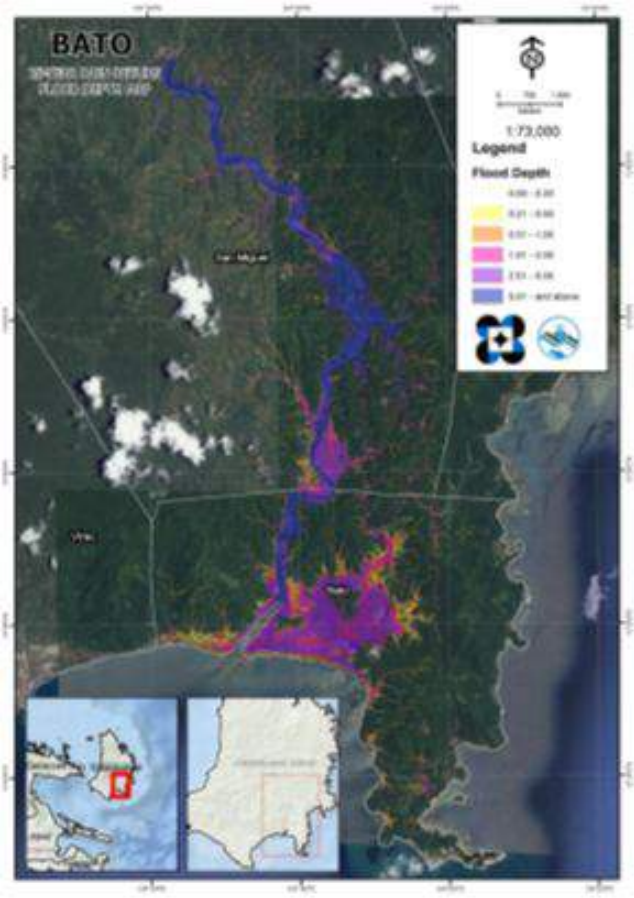
According to the City Profile of Bato, Catanduanes the topography of the place ranges from sea level to seven hundred (700) meters above sea level. As for the existing land use in the municipality, it is evident that the majority of the land is used for agricultural purposes (Fig.1). Another is, beside these agricultural spaces are the residential areas which shows that agriculture is one major source of livelihood. The Bato Baras Rd. is the major road that connects to the Catanduanes Circumferential Road which serves as an access to Bato and San Vicente (Fig. 2).

In the Catanduanes Watershed Forest Reserve 5-Year Management Plan (2010 – 2014) by the Department of Environment and Natural Resources (DENR), Catanduanes lies in the typhoon belt. Given this, the province of

Catanduanes has served as the "*last frontier,"* of the Bicol region in terms of forest area. However, over the years its forest areas have been depleted and in 1984 only 5,900 hectares of the 24,500 hectares remain.

According to the LiDAR Surveys and Flood Mapping of Bato River (2017), as forest area decreases, flood levels will continue to rise in the area. In recent news, Super Typhoon Rolly/ Goni, has caused destruction to Bato, Catanduanes. On the report of CNN Philippines (2020), over 10,000 homes have been totally washed-out by the aforementioned typhoon and food and water supplies are needed in evacuation centers. Moreover, 90% of electricity of posts and power transformers were disconnected. Hence, there is a great need for a more sustainable source of food, power, and electricity.

Facility Type	No. of Features
Residential	4863
School	171
Market	0
Agricultural/Agro-Industrial Facilities	1
Medical Institutions	18
Barangay Hall	32
Military Institution	0
Sports Center/Gymnasium/ Covered Court	4
Telecommunication Facilities	0
Transport Terminal	0
Warehouse	0
Power Plant/Substation	13
NGO/CSO Offices	0
Police Station	3
Water Supply/Sewerage	1
Religious Institutions	58
Bank	0
Factory	0
Gas Station	0
Fire Station	1
Other Government Offices	15
Other Commercial Establishments	31
New Building*	3
Total	5214



In relation to the LiDAR Surveys and Flood Mapping of Bato River (2017), there are over 5,000 buildings located in the Bato Floodplain (Fig. 3), these are structures that are more susceptible to flooding and damages caused by typhoons. Additionally, according to the LiDAR

survey 25-year Rain return flood depth map (Fig. 4) Bato, Catanduanes may experience floods that are at least 5 meters in depth. This flood depth map seems to remain true even in a span of 100 years when no action will be done.

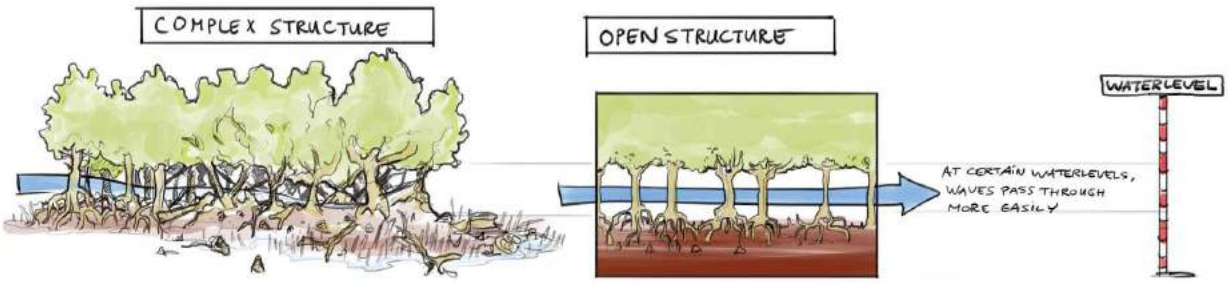
PROPOSED SOLUTIONS

Mangrove Belt for Coastal Defense

According to The Use of Mangroves in Coastal Protection (2012), coastal areas are prone to erode due to chronic erosion and typhoons, and the coast may be vulnerable to typhoons, storm surges, and tsunamis. In accordance to the study by the University of Cambridge on Mangroves for Coastal Defence (2014), three (3) factors are to be considered to assess the risk context of an area namely: hazard, exposure, and vulnerability (Fig. 5). Wherein, hazards are threats to lives, property, health and economic development. Exposure refers to the zone where people are located and how close they are to the hazard zones. Lastly, vulnerability is defined as the likability of a community to experience damaging effects brought about by the aforementioned erosion and high water events.

Mangroves are found to be a natural barrier to the aforementioned risks that coastal communities face. As discussed in The Use of Mangroves in Coastal Protection (2012), the advantages of a *"mangrove belt"* are to reduce the speed of waves caused by storm surges and tsunamis, and act as a barrier from the strong winds brought about by typhoons. According to Mangroves for Coastal Defence (2014), as sea water level increases and enters the mangrove belt it loses energy and reduces the height of the wave. This is due to the above-ground complex root

structure system of mangroves (Fig.6). It acts as an obstacle— blocking the water from further reaching into the coast.



Aside from protecting the coasts, mangrove forests protect sea biodiversity as well. As stated in The role of Mangroves in Coastal Protection (2020), mangrove forests restore and safeguard ecosystems which in turn, provide livelihoods and food security to the local community. Furthermore, mangrove belts maintain and allow for sea biodiversity and aquaculture to flourish with enhanced carbon storage. As for its social economic benefits, mangrove belts provide places for recreation; thus, enhancing human well-being.

Tourist Activities for Economic Growth

Nowadays, people crave for going on a vacation. A reason for this is to bond with their loved ones while appreciating the beauty of nature. It is also a way to destress from the busy schedules that they encounter in their day-to-day lives. A change in scenery results in better productivity and creativity when it comes to work.

Bato, Catanduanes is full of natural attractions. The province consists of mountainous landforms, sea attractions, and rock formations. The attractions in Bato are the Sakahon Beach, Locot Islands, Poseidon Rock Formations and the Mountains of Bato. New activities for promoting tourism include hiking. Due to the healthy vegetation in Bato, Catanduanes, the mountainside along the Bato Church serves as the perfect hiking spot for locals and foreigners alike.

After a long hike, a walk along the beach is sure to soothe the tired muscles from the hike. The beach, which is another attraction can serve as a scuba diving and surfing spot because of the abundant corals, the beautiful underwater view, and the big waves coming from the pacific ocean. The proposed beach activities also include the experience of nightlife. Restobars will be available in the area while experiencing the beauty of nature. Another form of tourist attraction is the windmills along the coast of the Eastern part of Bato, Catanduanes. In the Locot Islands, island hopping will also be available for tourists to enjoy. Biking activities are also available for the elderly and the children who have yet to appreciate beauty in hiking, in fact there are even ziplines direct to the beach or the Bato Church depending on the intent.

Providing Renewable Energy Resources for Electricity Generation

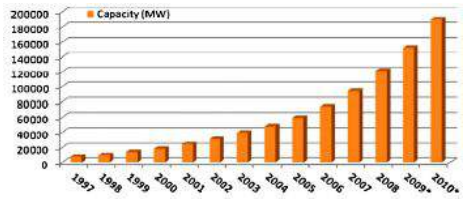


Fig. 3. Total world installed capacity [10].

According to the Environmental Impact of Wind Energy (2011), the demand for energy will only continue to rise in the next couple of years. Which is why, countries around the world are turning to renewable sources of energy like wind energy harnessing. Windmills and Wind turbines can be built on farmlands and especially on rural areas where winds are the strongest. In this way, the provincial areas can benefit economically.

A study on the Environmental Impacts of Wind Energy (2013) enumerates the benefits of harnessing and transforming wind energy into electricity. One major benefit is windmills do not emit any kind of hazardous waste. Another is, it can contribute to better air quality. Lastly, windmills are often listed as tourist spots. An example of which is our very own windmill farm located in Bangui, Ilocos Norte (Fig. 11).

Furthermore, solar power is also a possible energy generator as it is the energy from the sun that is converted into thermal or electrical energy, and considered one of the cleanest and most abundant renewable energy available (SIEA, 2020).

Solar power therefore requires solar panels to be located on an efficient spot where sunlight is most generous. These are to be integrated into street lights to reduce the overall consumption, maintenance, pollution, and even accidents as the use of electrical wires are minimized.

Esplanade as a Coastal Buffer and Open Space

According to Wikipedia, an esplanade or promenade is a long, open, level area, usually next to a river or large body of water, where people may walk. Since the residential area in Bato is situated near the coast, it is found to be extremely vulnerable to its tides. Providing an esplanade to serve as a coastal buffer will help alleviate this recurring issue as it elevates the city and distances its community structures from the coastal area. An example of which is the Iloilo River Esplanade (Fig. 12).

The first ever civilization to acknowledge the importance of an open space were the Romans due to its beneficial features. These

spaces were an image of one's wealth and power, but aside from that, it also promoted the growing significance of one's health and well-being. '*Rus in Urbe*' is a phrase coined by Romans, which refers to country features found in towns or cities. It has become a desirable aspect, as early as the 17th century, since it gives an illusion of a countryside within a city. Aside from its enhancement of cities aesthetic wise, it stood as an ornament for pleasure and recreation that delighted the community as a whole since it provided a space for tranquility, fresh air, and a reminder of their country estate.

Often referred to as the "lungs" of the city, public open spaces began to widely spread to improve the health and quality of living of the working classes in a congested city. Urbanization refers to the shifting of a population from a rural to an urban setting. Undergoing this process could be greatly influenced by the want and need of a community of an easy lifestyle.

One of the most common reasons to migrate are better work opportunities, which are typically found in metropolitan cities, causing the population of the area to continually grow hence the need to open commercial spaces to tend to the needs of the people. Although this opens better opportunities for the residents in close proximities, it also closes green spaces that are vital to a community. This serves as a big sacrifice to one's health and wellbeing as the community is being robbed of being in contact with nature, which is essential in living.

Accessible to the public, an open space is generally an undeveloped area free of any built structures. It could be parks, community gardens, cemeteries, schoolyards, playgrounds, seating areas, plazas, and vacant lots. Typically made for leisure and recreational use of the community and aesthetic purposes. But due to the increasing number of commercial spaces, public open spaces became a necessity in a community.

Human life revolves around the ecosystem which provides the basic needs for one's survival. It is clear that access to some form of "nature" is a fundamental human need (Thompson 2002). Fredrick Law Olmsted (1903), Kaplan and Kaplan (1989), and others, suggest that if cities fail to provide natural relief from the urban environment, there will be substantial health costs in the long run (Thompson 2002; Tong and Ding 2011).

Public open spaces provide a place for relationships to blossom and flourish. But since more and more cities have grown to be urban, these spaces continue to decline each year. From FL Olmsted onwards (Ward Thompson, 1998; Kaplan and Kaplan, 1989) implied that urban environments that lack in natural reliefs could induce great costs to the community's health.

It is predicted that by 2022, population in cities will be greater than those in the countryside. According to Asian Development Bank, an estimation of 120,000 people move into cities per day and more than 700 million live in urban squalor, which is dehumanizing as they are lacking in clean basic needs. Asia is known to have the biggest land mass in the world. Its urban areas have grown significantly more than any other in the world. These changes opted the community to build more infrastructures that would tend to their needs, thus increasing its carbon footprint. Asia is proven to have 11 of 20 of the most polluted countries and is one of the top economies that emitted carbon, therefore contributing greatly in the growth of climate change. This has then caused the entire continent to experience more frequent environmental challenges such as flooding, deforestation, water scarcity, pollution, and etc. These problems in turn cause more issues as it continually destroys their surrounding environment that is greatly vital for their survival, such as disruption of food production for the community brought by heavy rainfalls.

Numerous implications could be drawn from a public open space, whether it is present or absent in a community. Its effects could visibly be seen on the community's growth, and it may range from physical, psychological, social, and ecological aspects.

Regular physical activity is one of the many requirements in obtaining a healthy lifestyle. Public health literature has established physical inactivity as a major health problem on par with other risk factors for mortality and chronic disease (Haskell et al. 1995, Frank and Engelke 2001). Providing an accessible, affordable, and enjoyable area to be physically active could help promote habitual healthy behaviors such as regular exercise to address these types of problems, especially for people living in an urban setting. Improvement in physical health and mental wellbeing are some of possible outcomes of obtaining a healthy lifestyle.

Mental health is a public health priority globally. Public open spaces provide a solid foundation for a green environment to thrive in. Various studies have shown that regular contact with nature helps strengthen mental health as it serves as an area free from congestion from the city as it provides its community with fresh air and tranquility. Natural environments with vegetation and water tend to induce a relaxed and less stressful state in observers (Maas et al. 2006). This ability of natural elements to function as a type of 'tranquilizer' may be particularly beneficial in urban areas where stress is a common aspect of daily living. Ulrich (1984) found that hospital patients who could look out and see trees and other natural elements from their

window recovered more quickly than those whose view was restricted by buildings. Like Ulrich, Maas et al. (2006) discovered a positive association between perceived general health of residents with the percentage of green space in their living environment. Urban nature provides psychological benefits to human societies, which enrich human life with meanings and emotions (Chiesura 2004). Studies which focus on the psychological effects of nature such as Hartig, 2008; Kaplan, 2001; Rossman, 1977; Ulrich, 1984, show that the importance of contact with nature extends beyond aesthetic benefits and includes a range of other benefits pertaining to psychological well-being (Maller et al. 2009). Benefits include the restorative effects, such as increased levels of happiness, which come from interacting with the natural environment (Baycan-Levent et al. 2009; Groenewegn et al. 2006).

Public open spaces could also serve as an area for socialization, enticing the community to gather around and build a network among its residents. Lord Rogers' Urban Task Force report (1999) stated that "to achieve urban integration means thinking of urban open space not as an isolated unit—be it a street, park or square—but as a vital part of urban landscape with its own specific set of functions. Public space should be conceived of as an outdoor room within a neighbourhood, somewhere to relax, and enjoy the urban experience, a venue for a range of different activities, from outdoor eating to street entertainment; from sport and play areas to a venue for civic or political functions; and most importantly of all a place for walking or sitting-out. Public spaces work best when they establish a direct relationship between the space and the people who live and work around it". A community with constant communication is fundamental in developing progress within the city. This could entail numerous qualities that could be obtained to form a healthy community, such as the diminishing of inequality, gender roles, discrimination, and such.

But the biggest impact a public open space could provide is seen ecologically as it comprises an area full of vegetation or most commonly known as a green space. Human life is dependent on the ecosystem for survival as it is the main provider of materials essential to living. Since they are renewable resources, it helps clean, maintain, and protect the environment in pristine condition. Nature acts as a natural barrier for environmental hazards to help protect the community and its resources. For example, preserving a large scale forest could avoid flooding brought by heavy rainfalls. Plants provide natural drainage that could intake a substantial amount of water. They are also environmental agents that could reduce air pollution, noise, and extremes

of temperature in urban settings. Disregarding public open spaces in place of commercial spaces will increase the harm of key environmental exposures. As global warming continues to grow, this will especially be more vital for future protection from natural occurrences.

There is convincing evidence that the availability of public open spaces within urban areas benefits the health and wellbeing of a community. Green space is related to improving health regardless of socioeconomic status. The implications, however, greatly depend on the quantity and quality of a public open space in a community. Poorly made open spaces does not guarantee health benefits. Careful urban planning is thus highly recommended in establishing these areas. There are also good outcomes in developing superior quality public open areas that give a substantial number of benefits that will help communities in the long run, physically and environmentally. Constructing laws requiring public open spaces should also be implemented. This will serve as a natural barrier for protection against future problems. Public open spaces are designed to provide a safe environment for the community to use for different aspects in their lives, whether it is physically, psychologically, socially, and ecologically.

City Planning

According to CNN Philippines, the devastation Typhoon Rolly brought Catanduanes destroyed over 10,000 homes. In addition to this, both major and minor road networks have been affected heavily, causing difficulty in terms of moving from place to place which they need efficiency, especially because of their current condition. Since Bato is an agricultural city, there is no available marketplace not only for those on vacation, but also for the elderly that aren't strong enough to continue with fishing or farming.

The municipal city hall however, which is currently located beside the Bato Church, is to be relocated to the center of their residential areas. This increases the accessibility of residents, specifically those with concerns, in contrast to having to travel a long distance. The marketplace along with various shops and restaurants can also be found near the municipal city hall so that all important offices are in one area.

Creating a Central Business District

A Central Business District is the commercial and business center of an area. It has the most land use and usually has the busiest streets. Having a CBD is efficient for people as this is where they could have an experience of everything all at the same time.

Bato, Catanduanes is a secluded area in the Bicol Region. This Municipality is composed of 27 barangays and has a total land area of 4,990 hectares. Having a CBD in this municipality will increase its value and may attract tourists. This would also give opportunity for its locals to have more jobs. Bato, Catanduanes is known for its natural resources. Its locals are known to make and harvest their own food. Bato has a lot to offer and one of them is their fisheries and agriculture. Having a CBD where a central market will be placed, its locals will be able to sell and share their own products and profit from it. Exportation could also be expected when these businesses grow.

It is a given that the Bato, Catanduanes is not as busy as the ones in the Metro. A lot of the roads going to the outskirts of the province consist of rough roads. According to a case study done by Development Asia in 2019, the Makati Central Business District is starting to create more pedestrian walkway networks. This resulted in more connected developments. Bato as a not-so busy area, giving importance to pedestrians would help the community to be more connected and one.

Bato Church Plaza

The Bato Church, also known as St. John the Baptist Church is situated on a hill oriented facing the Bato River (Fig.). As reported in the Catanduanes Tribune in 2019, the Church took over fifty (50) years to be complete and is considered to be a provincial heritage site. Its walls

are made of rubble stones, coral stones, and egg whites as binder. The walls were built to withstand the harsh typhoons and earthquakes that frequent the land.

As cited in an ABS-CBN news article in 2020, Manila Bulletin has reported that the Church had gone under restoration for two (2) years. The National Historical Commission of the Philippines had allocated Php 8.6 million to restore the Church. Unfortunately, not long after it had been restored Typhoon Rolly (Goni) made landfall at Bato, Catanduanes the Church and municipality suffered major damage (Fig.).

With the interiors of the Church destroyed, mass is currently not being held. The group proposes an outdoor plaza, where mass gatherers are able to express their religious beliefs. However, public health concerns such as COVID-19 are still a pressing issue with regard to community spread of the virus.

In a study on COVID-19 and outdoor safety: Considerations for use of outdoor recreational spaces (2020), a public square or open space can make a contribution toward the social well-being of the community. Thereby, improving the mental health of people in the community after surviving the horrors of the typhoon during a pandemic. In terms of safety, the World Health Organization (WHO) released guidelines regarding small public gatherings which stated that gathering at a outdoor venue is a good precautionary measure. With proper social distancing, hygiene, and respiratory etiquette, the community has a communal space where they get to go outside their bubbles and still be safe. As of October 2020, the COVID-19 Inter-Agency Task Force has allowed religious gatherings not more than thirty percent (30%) of seating capacity to ensure every one’s safety.

PROPOSED SITE PLAN

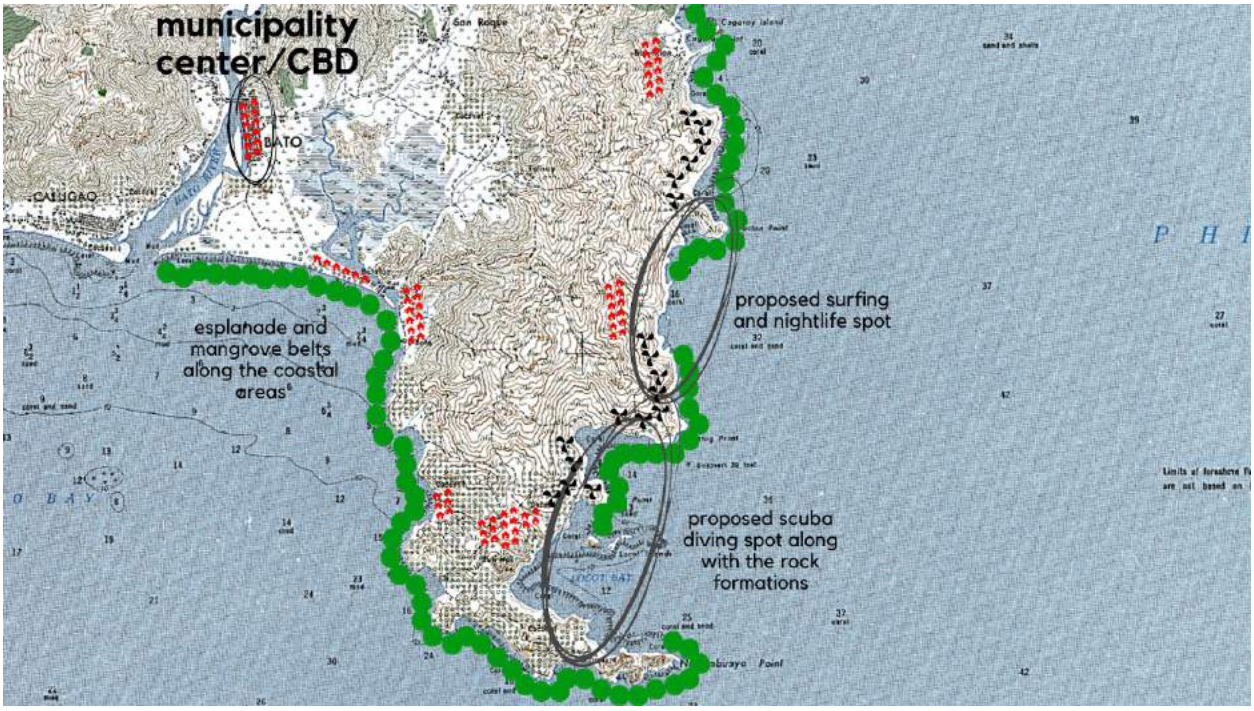
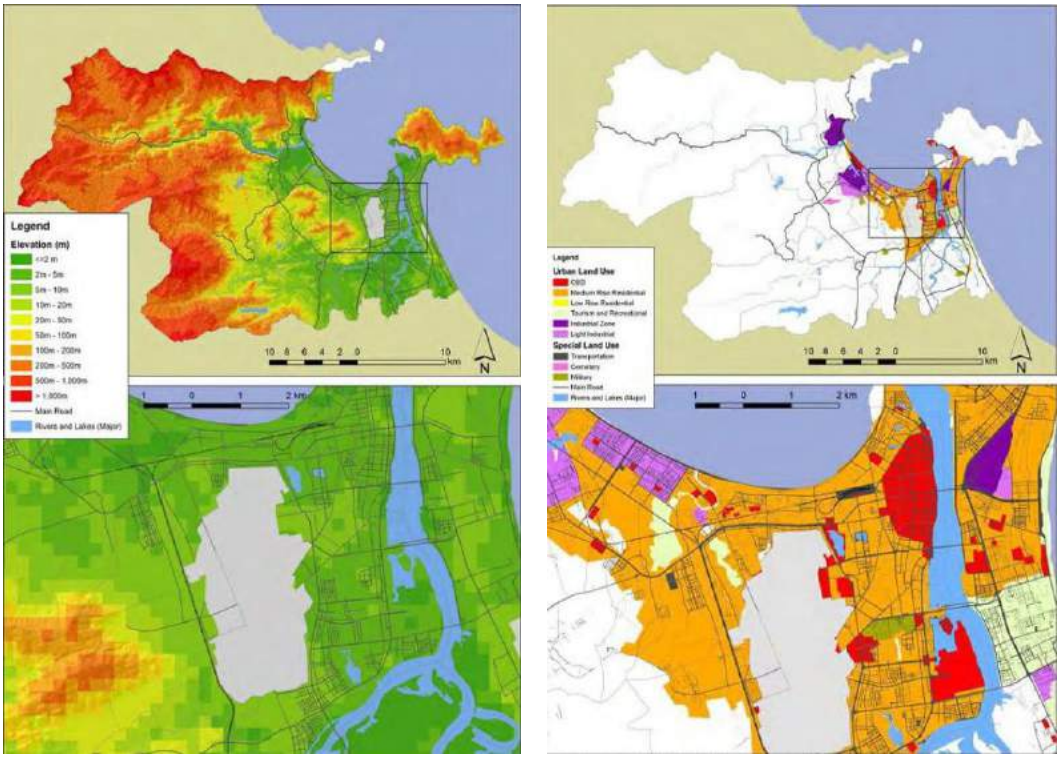


Fig. 13 Proposed Site Plan

CASE STUDIES

Da Nang, Vietnam

As stated in the Urban Development and Flood Risk in Vietnam: Experience in Three Cities (2017), climate change poses a growing risk in the cities of Vietnam. Given that most of the cities are located along its coastal or river deltas which have relatively low elevations pose susceptibility to flooding. The city of Da Nang is no exception, its elevation ranges from two (2) meters above sea level to above one-thousand (1,000) meters above sea level (Fig.14). According to a study by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2017) on Da Nang city, despite its low-lying conditions, the city is a transport, education and commercial hub for central Vietnam. The urban land use map of Da Nang shows that Medium Rise Residential structures make up most of the city (Fig. 15).

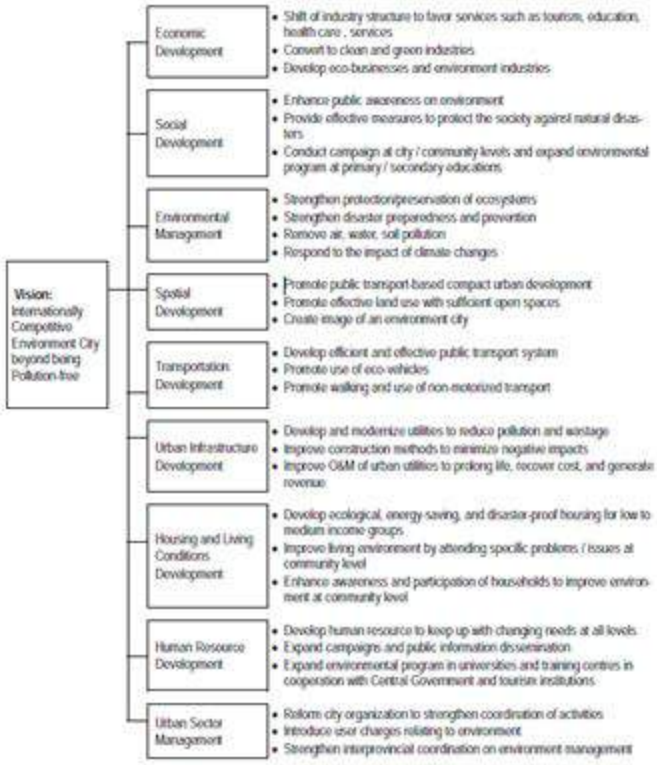


Da Nang City is frequented by typhoons. In 2006, Typhoon Xangsane made landfall in Da Nang and flood levels were as deep as two (2) meters. As reported by the Vietnam News, 26,000 houses were damaged and families were left homeless for days and built temporary shelters on roads. Moreover, in 2013 Typhoon Haiyan forced 20,000 families to evacuate to storm shelters and nearby provinces. The Bangkok Post reported that Typhoon Haiyan was the strongest typhoon to trail the East Sea and was comparable to typhoons such as Andrew and Katrina. In fact, the flood lasted for five (5) days after the typhoon made landfall. As discussed in Urban Development and Flood Risk in Vietnam: Experience in Three Cities (2017), due to the frequent typhoons and flooding in the area, water reservoirs were put in place; however, due to the amount of rainfall were full.

As a way to mitigate flooding in area the study of UNESCAP on Da Nang City (2017), states that the Da Nang city socio-economic Master plan towards 2020, with a vision to 2030 focuses on three (3) sustainable development goals (SDGs) numbers 11, 12, and 14 which are sustainable cities and communities, responsible consumption and production and life below water respectively. SDG 11 objective is to reduce the negative environmental impact in urban

areas by improving air quality, and management of urban waste. The objective of SDG 12 is to substantially reduce waste generation by recycling, reusing, and recovering energies from waste treatments. Lastly, SDG 14, is to control marine pollutions, protect and propagate sea biodiversity.

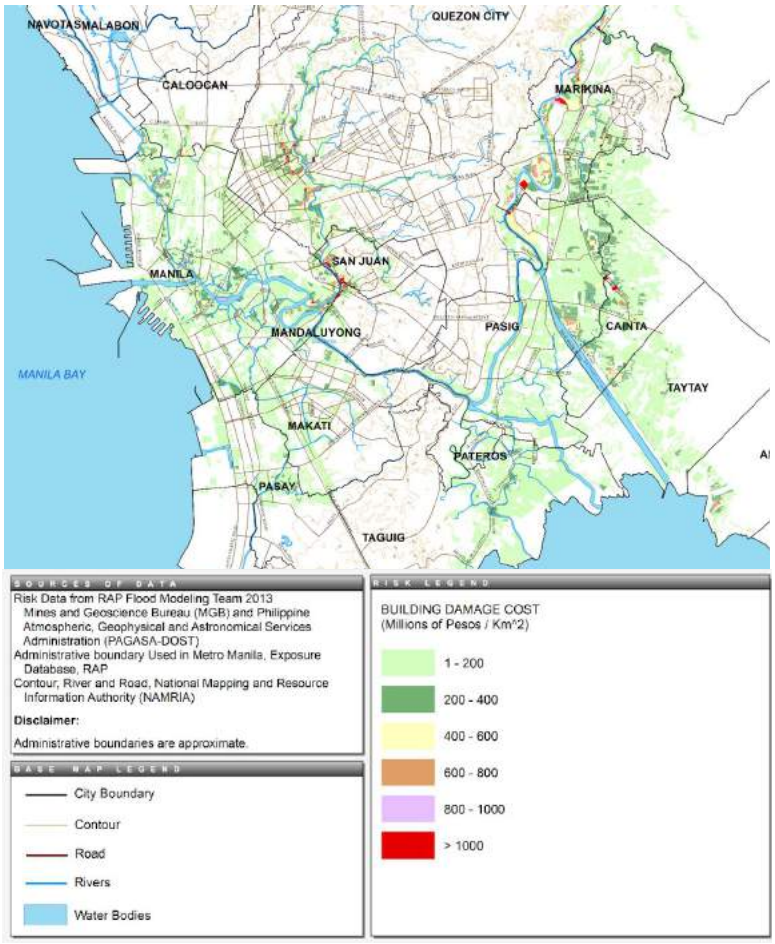
Its success as one of the main drivers of the regional economy over the years is because of the Da Nang City Development Strategy. According to the Study on the Integrated Development Strategy for Da Nang City and Its Neighboring Area (2010), the development strategy of the city is aligned to its vision of being an internationally competitive environment city beyond being pollution free. With this, its objectives for economic, social, environmental, and urban developments (Fig.16). As seen in Figure 15, the natural environment of the city is its driving force.

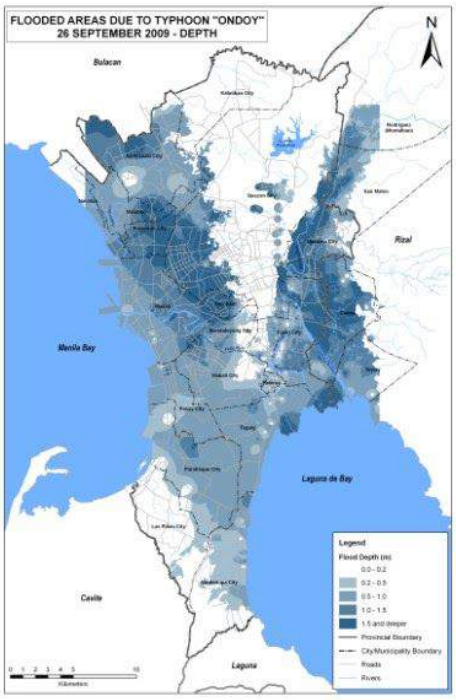


Typhoon Ondoy

Metro Manila is located in a low-lying area which is surrounded by sea, a large lake, and two river systems which makes the area prone to disasters. These unfortunate events are caused by climate change such as tropical cyclones, flooding, coastal erosion, and land subsidence. These changes will lead to change in temperature and sea level. Coastal areas of Metro Manila communities are in danger of being submerged. Manila is situated about five (5) meters above sea level making it the lowest of the cities surrounding it. Manila is the capital city of the Philippines. It is the center of political, economic and socio-cultural activities of the country. Metro Manila holds the highest gross regional domestic product (GRDP). It is expected for the region to lead the country's economy until at least 2050.

Metro Manila consists of 16 cities and 1 municipality (Fig. 17). These all lie within the Pasig-Marikina-Laguna Lake Complex with a catchment area of four thousand six hundred seventy eight (4,678) square kilometers. The only passage the Laguna Lake, the largest lake in the Philippines with an area of nine hundred (900) square kilometers, can flow through is the Pasig River. With a catchment that has an area of three thousand eight hundred and twenty (3,820) square kilometers, this allows water from various river basins to be stored. Water levels depend on the season. During the summer months, it is on 10.5m and 12.5m in the rainy seasons. The average level is 11.32m. Another problem that this lake faces is that when Manila bay is higher. Seawater flows back to the lake.





In Figure 18, it shows the estimates of the building damage caused by the typhoon ondoy. It only considers direct structural damages and not the building contents. In Figure 19, it shows the flooded areas due to typhoon ondoy.

According to Sato and Nakasu's research, the key component of Metro Manila's flood control is the Manggahan Floodway. This floodway's drainage capacity is 2,400 cubic meters per second. According to the research of Sato and Nakasu in 2011, to protect regions from the overflow that might happen with the rise of Laguna lake, it is planned to construct a 9.5km coastal bank, 8 weirs, and 4 drainage pump stations.

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