Chapter 2. Geophysical Environment

Geographical Location

Cavite is part of the Philippines' largest island, the Luzon Peninsula. Found in the southern portion, Cavite belongs to Region IV-A or the CALABARZON region. The provinces of Batangas in the south, Laguna in the east, Rizal in the northeast, Metro Manila and Manila Bay in the north, and West Philippine Sea in the west bounds the Province. Cavite has the GPS coordinates of 14.2456º N, 120.8786º E. Its proximity to Metro Manila gives the province a significant edge in terms of economic development.

Political Boundaries

The province of Cavite has well-defined political subdivisions. Considering the rising population of the province, the addition of new legislative districts is a good move to ensure the befitting representation of the province in Congress. Republic Act No. 11069, effective in the year 2018 and to commence on the next national and local elections, reapportioned the province into eight legislative districts. The Act declared 6th District as the lone district of City of Gen. Trias; 7th District is now composed of Amadeo, Indang, Tanza, and Trece Martires City; and 8th District is the then municipalities and city in the 7th District except Indang. The move to increase the number of congressional representatives in Cavite aids the province to have better representation in the national government and in effect receive more appropriate government services and assistance.

Currently, the Province is composed of 16 municipalities and 7 cities with a total of 829 barangays (Table 2.1). The seven cities include the seat of the Provincial Government – Trece Martires City, the defense frontier – Cavite City, the provincial summer capital – Tagaytay City, the City of Dasmariñas under the Republic Act 9723 which was ratified last November 25, 2009 and which also happens to be a lone legislative jurisdiction of 4th District, City of Bacoor and City of Imus by virtue of RA 10160 dated February 08, 2012 and RA 10161 dated April 10, 2012, respectively, and the newly converted City of Gen. Trias through Republic Act 10675 which was signed into law on August 19, 2015 and ratified on December 12, 2015.

Presidential Decree 1163 declared the City of Imus is the de jure provincial capital, and Trece Martires City is the de facto seat of the provincial government.

In addition, in 1909, during the American regime, Governor-General W. Cameron Forbes issued the Executive Order No. 124, declaring Act No. 1748 that annexed Corregidor and the Islands of Caballo (Fort Hughes), La Monja, El Fraile (Fort Drum), Sta. Amalia, Carabao (Fort Frank) and Limbones, as well as all waters and detached rocks surrounding them to the City of Cavite. These are now major tourist attractions of the province. The municipality of Ternate also has Balut Island.

Table 2.1 ***Number of barangays by city/municipality and congressional district; Province of Cavite: 2018***

City/Municipality	Number of Barangays
1st District	**143**
Cavite City	84
Kawit	23
Noveleta	16
Rosario	20
2nd District	**73**
City of Bacoor	73
3rd District	**97**
City of Imus	97
4th District	**75**
City of Dasmariñas	75
5th District	**105**
Carmona	14
Gen. M. Alvarez	27
Silang	64
6th District	**33**
City of Gen. Trias	33
7th District	**116**
Amadeo	26
Indang	36
Tanza	41
Trece Martires City	13
8th District	**187**
Alfonso	32
Gen. Emilio Aguinaldo	14
Magallanes	16
Maragondon	27
Mendez	24
Naic	30
Tagaytay City	34
Ternate	10
Total	**829**

Source: Provincial Planning and Development Office

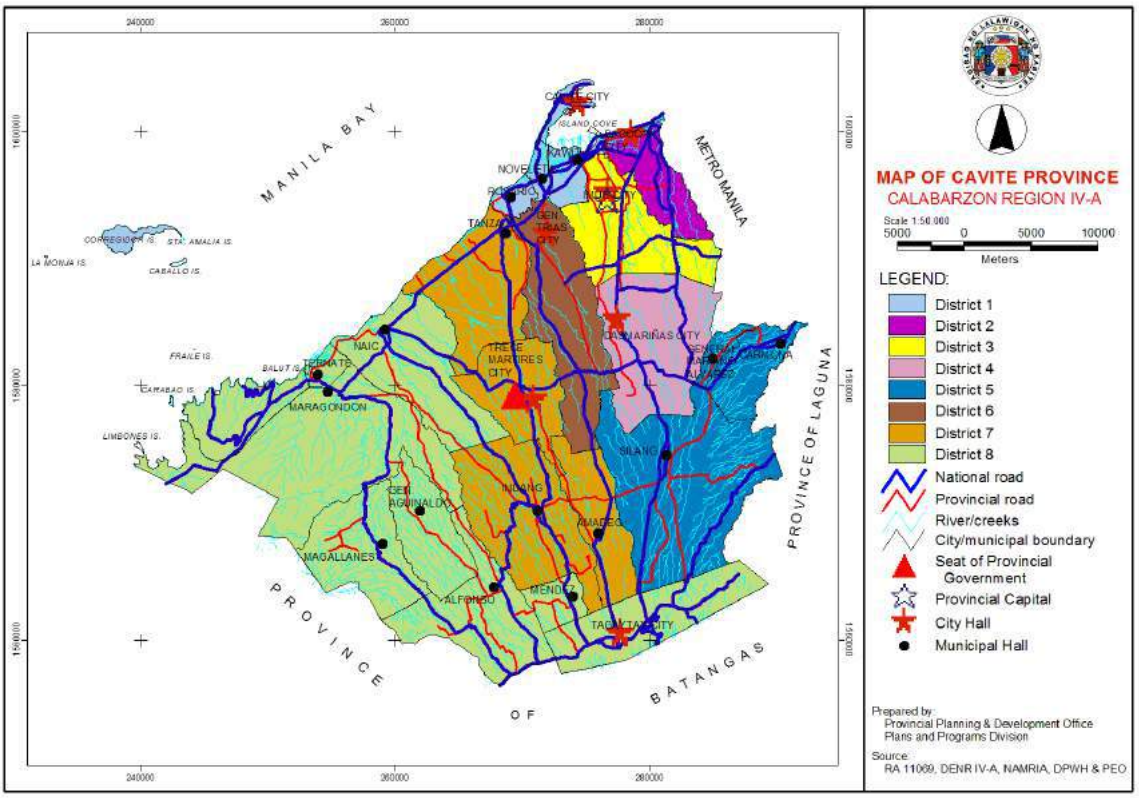

Figure 2.1 *Legislative Map of Cavite Province*

Land Area

Land is an important resource that is a basis of many governance related decisions such as budget, cityhood, and programming, among others. Land, referred to as dry land, is the solid surface of the Earth that is not permanently covered by water. It is an area of ground which is being used for a particular purpose. It excludes area below inland water bodies. The proper usage of land is a major determinant or guiding force on the progress of a province.

Cavite covers 8.72 percent of the CALABARZON's land area. This is relatively small, considering that there are only five provinces in the region. The land area of Cavite is equivalent to only 0.48 percent of the total land area of the Philippines; which is 142,706.00 hectares. The municipality of Maragondon has the largest land area covering 16,549 hectares while the municipality of Noveleta has the smallest land area with 541 hectares.

Table 2.2 *Land Area by City/Municipality, Province of Cavite: 2018*

City/Municipality	Land Area (hectares)	Percent Distribution
1st District		
Cavite City	1,183	0.83
Kawit	1,340	0.94
Noveleta	541	0.38
Rosario	567	0.40
2nd District		
City of Bacoor	5,240	3.67
3rd District		
City of Imus	9,701	6.80
4th District		
City of Dasmariñas	8,234	5.77
5th District		
Carmona	3,092	2.17
Gen. M. Alvarez	938	0.66
Silang	15,641	10.96
6th District		
City of Gen. Trias	11,768	8.25
7th District		
Amadeo	4,790	3.36
Indang	8,920	6.25
Tanza	9,630	6.75
Trece Martires City	3,917	2.74
8th District		
Alfonso	6,460	4.53
Gen. Emilio Aguinaldo	5,103	3.58
Magallanes	7,860	5.51
Maragondon	16,549	11.60
Mendez	1,667	1.17
Naic	8,600	6.03
Tagaytay City	6,615	4.64
Ternate	4,350	3.05
Total	**142,706**	**100.00**

Source: Provincial Development and Physical Framework Plan 2011-2020

Topography

Physiological Areas

COASTAL PLAIN is the lowest lowland area. These areas have an extremely low ground level of EL. 0m to EL. 2m compared to the high tide level of about EL. 0.8m from the Mean Sea Level (MSL). These are the city of Bacoor and municipalities of Kawit, Noveleta, and Rosario.

UPLAND MOUNTAINOUS AREA is situated at a very high elevation above EL. 400m with slopes of more than 2%. Amadeo, Silang, Alfonso, and Tagaytay City have this topography. The Tagaytay ridge has a peak elevation of 650m.

COASTAL AND ALLUVIAL PLAINS is considered the lowland areas. These areas have a flat ground slope of less than 0.5% and low ground elevation of EL. 2m to EL. 30m. The city of Imus and the southern part of the City of General Trias are alluvial plains. Into these municipalities forms the transition area between the coastal plain and the central hilly area. It also covers some areas of City of Bacoor, Kawit, Noveleta, Rosario, and Tanza.

CENTRAL HILLY AREA is found on the mountain foot slope and forms rolling tuffaceous plateau. This topography includes steep hills, ridges, and elevated inland valley. The plateau has a ground elevation ranging from 30m to nearly 400m and a ground slope ranging from 0.5 to 2%. The cities of Trece Martires and Dasmariñas and the municipalities of Indang and Silang have this kind of topography.

Slope

Slope is the degree of inclination of a given area. It is the number of feet the land rises or falls over a distance of 100 feet and written in terms of percentage. The degree of slope affects soil moisture; which influences species selection. It also estimates the erosion potential of the place and helps in selecting the most appropriate planting techniques. Slopes of 15% to 20% may be erosion prone.

The National Land Use Committee prescribes the following standard slope ranges:

- 0 – 3% : Flat or level land
- 3% - 8% : Level to undulating
- 8% - 18% : Undulating to rolling
- 18% - 30% : Rolling to moderately steep hills
- 30% - 50% : Moderately to steeply mountainous
- Above 50% : Very steeply mountainous

In Cavite, the northern part of the province is flat or level. This is consisting of the parts of the municipalities of Ternate, Maragondon, Naic, Tanza, Rosario, Noveleta, Kawit, and cities of Cavite, Bacoor, and Imus. The westmost part of the province, mostly parts of Maragondon, Ternate and Magallanes, is ranging from moderately steep to very steep as well as the eastmost part covering the municipalities of General Mariano Alvarez and a small portion of Carmona and Silang including the city of Tagaytay. These areas are the most prone to erosion in the province of Cavite. Lastly, the remaining cities and municipalities are gently sloping to undulating to rolling (Figure 2.2).

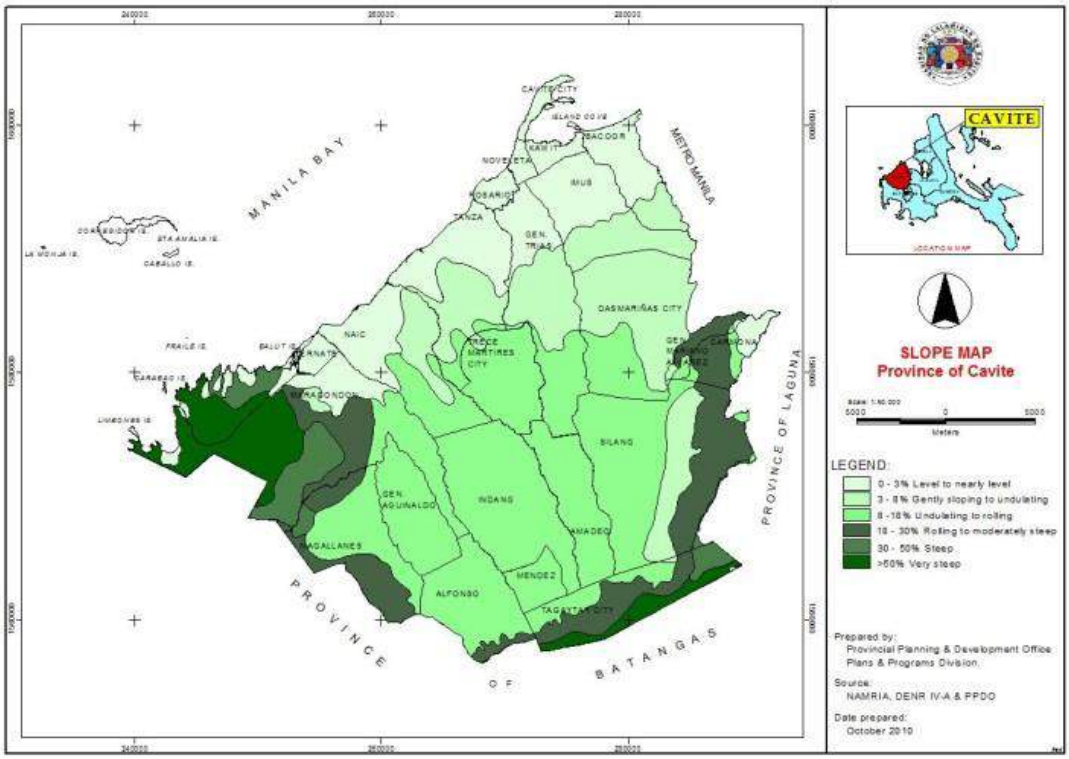

Figure 2.2 **Slope Map of Cavite Province**

Geology

Geology is the study of Earth, the materials which it is made, the structure of those materials, and the processes acting upon them. Physical geology is made important in this sub-chapter. Physical geology deals with the study of the physical features of the earth and the processes acting on them. This includes volcanoes, earthquakes, rocks, mountains, and the oceans; just about any feature of the earth.

Landforms

According to the National Geographic Society, landforms are features on the Earth's surface that are part of the terrain. The four major types of landforms are mountains, hills, plateaus, and plains. Buttes, canyons, valleys, and basins are considered minor types of landforms.

The Philippines, fondly called as the "Pearl of the Orient" has its diverse environment, well known for its different landforms. Some of it can be found in the province of Cavite.

The province of Cavite has its own share in the mesmerizing beauty of nature that every Filipinos can enjoy. Pico de Loro, also known as the Parrot's Beak, is one of the most popular mountains in the Philippines. The wide plains of Cavite and the West Philippine Sea, as well as the coves and beaches of Nasugbu, can be seen at the peak due to its elevation of 688 meters. Mt. Pico de Loro is part of the Mt. Palay-Palay-Mataas-na-Gulod Protected Landscape, the remaining lowland rainforest in Cavite, covering particularly Maragondon and Ternate, and Batangas. Mount Marami, one of the ancient volcanic features of Bataan Arc, Mount Buntis and Mount Nagpatong, home to Andres Bonifacio Shrine and claim to be the execution site of the said hero, are other notable mountains in Cavite. Another peak in Cavite is the Mt. Sungay (Mt. Gonzales) in Tagaytay. The inactive stratovolcano is the highest point in Cavite at 709 meters.

Another noteworthy landform in Cavite is the Lucsuhin National Bridge, locally called Cabag Cave or Lucsuhin Cave, is a national bridge connecting Barangay Lucsuhin and Barangay Kalubkob in Silang, Cavite. The bridge crosses Ylang-ylang River and the first national bridge reported in the country.

Soil Types and Classification

Identification of soil characteristics, most importantly the soil type, is a vital activity in area profiling. This is very useful in recommending the best land-use for that area. Moreover, if intended for agriculture, knowing the soil type will also aid in identifying the most suitable crops to be planted in the area. This will contribute to the achievement of optimized land productivity.

Lucsuhin National Bridge

The soil surveys conducted by the Bureau of Soils and Water Management (BSWM) revealed that Cavite is composed of ten (10) soil types.

The lowland area of Cavite is generally composed of Guadalupe clay and clay loam. This soil type is characterized as coarse and granular when dry but sticky and plastic when wet. Its substratum is solid volcanic tuff. These types of soils are suited to lowland rice and corn while those in the upland are suited for orchard and pasture.

Guadalupe clay adobes are abundant in the southern part of the cities of Bacoor and Imus bordering the city of Dasmariñas. The soil is hard and compact and difficult to cultivate that makes it generally unsuitable for diverse cropping. It is very sticky when wet and granular when dry. Forage grass is advised for this type of soil.

Hydrosol and Obando sand are found along Bacoor Bay. The shoreline of Rosario, Tanza, Naic, and Ternate are lined with Guadalupe sand.

The central area principally consists of Magallanes loam with streaks of Magallanes clay loam of sandy texture. This is recommended for diversified farming such as the cultivation of upland rice, corn, sugarcane, vegetables, coconut, coffee, mangoes, and other fruit trees. The steep phase should be forested or planted to root crops.

The eastern side of Cavite is consists of Carmona clay loam with streaks of Carmona clay loam steep phase and Carmona sandy clay loam. This type of soil is granular with tuffaceous material and concretions. It is hard and compact when dry; sticky and plastic when wet. This type of soil is planted to rice with irrigation or sugarcane without irrigation. Fruit trees such as mango, avocado, and citrus are also grown in this type of soil.

Guingua fine sandy loam is found along the lower part of Malabon and Ylang-ylang River at Noveleta.

The type of soils that dominate the upland areas is Tagaytay loam and Tagaytay sandy loam with mountain soil undifferentiated found on the south-eastern side bordering Laguna province. Also, on the southern tip are Magallanes clay and Mountain soil undifferentiated with an interlacing of Magallanes clay loam steep phase.

The Tagaytay loam contains fine sandy materials, moderately friable, and easy to work on when moist. In an undisturbed condition, it bakes and becomes hard when dry. About one-half of this soil type is devoted to upland rice and upland crops. On the other hand, Tagaytay sandy loam is friable and granular with a considerable amount of volcanic sand and underlain by adobe clay. Mountain soil undifferentiated is forested with bamboos found in the sea coast. Cavite also has the Patungan sand characterized by pale gray to almost white sand with a substratum of marine conglomerates. It is found at Sta. Mercedes in Maragondon and in some coastlines of Ternate.

Land Suitability

Land suitability is the fitness of a given type of land for a defined use. The process of land suitability classification is the appraisal and grouping of specific areas of land concerning their suitability for defined uses.

Majority of Cavite's area is for highly restricted agricultural use. The lowland areas covering the cities of Imus, Bacoor and General Trias, portions of the municipalities of Tanza, Naic and Rosario are primarily suitable for irrigated rice/freshwater fishponds. The central part of the Province covering mainly the city of Dasmariñas, large portions of Tanza, Naic, Gen. Aguinaldo and Trece Martires City are primarily suitable for cultivated annual crops. Cavite's upland area covering the municipalities of Silang, Amadeo, Indang, Alfonso, Magallanes and a small portion of Gen. Aguinaldo and Maragondon and the City of Tagaytay is principally suitable for perennial tree and vine crop production.

The mountainous portions of the Province found at the western side and the area along the Tagaytay Ridge is considered as National Integrated Protected Areas System (NIPAS) land which cannot be altered from its natural habitat (Figure 2.3).

The land suitability information was from the Land Management Unit (LMU) map from the Bureau of Soils and Water Management (BSWM). This information will be used to determine whether the present land use is in congruence with the suitability of the land for that use.

Land Resources

Land Classification

Land classification ensures the proper location of various land uses, especially of business, residential, and utility areas. This is executed by highly trained urban planners to ensure the harmonious movement of people and their activities. Land classifications and adherence to them by the public promote balanced development.

The land resource of the province is at 142,706 hectares. This is categorized into Alienable and Disposable (A&D) Land and Forest Land. The Alienable and Disposable Land accounts for 129,391 hectares or 90.67 percent share to a total land resource where economic activities (Agriculture – 55.24 percent share to A&D) and human settlements (44.76 percent share to A&D) occur. On the other hand, forestland, the land covered with forest or reserved for the growth of forests, is 9.33 percent or 13,315 hectares shared to the total. It is assumed that land resource is preserved to maintain the ecological balance in the province (Table 2.3).

Table 2.3 *Land Classification, Province of Cavite: 2011 - 2020*

Land Classification	Area (ha)	% Share	% Share to Classification
A. Alienable and Disposable Lands	**129,391.00**	**90.67**	
Production Land	71,474.91	50.09	55.24
Built-up Area	57,916.09	40.58	44.76
B. Forest Lands	**13,315.00**	**9.33**	
1. Classified	5,357.36	3.75	40.24
a. Protected Areas/ Natural Parks	3,928.00	2.75	
b. Military Reservation	808.99	0.57	
c. Islands	620.37	0.43	
2. Unclassified	7,957.64	5.58	59.76
Total	**142,706.00**		

Source: Provincial Development and Physical Framework Plan 2011-2020

Alienable and Disposable Lands

As defined by the Philippine Statistics Authority (PSA), alienable and disposable lands refer to those lands of the public domain which have been the subject of the present system of classification and declared as not needed for forest purposes. It is further classified into production land and built-up areas.

The production land is the area where agricultural activities and food productions takes place. Most of the areas in Cavite are of this classification (50.09%).

The built-up areas, on the other hand, are comprised of settlements, industrial, commercial and tourism areas. This area is mainly for the conduct of economic activities as well as for human habitations. It covers up to 40.58 percent of the total land area of Cavite.

Forest Lands

The forest lands are those that have either national proclamation to become forest reservations or those lands that are not suitable for any particular use. This may be a factor of topography and elevation. Forest lands are divided into two kinds the classified land, which includes protected areas/natural parks, military reservation and islands, and unclassified land, also known as the public forest.

Under classified lands, Mount Palay-Palay and Mataas na Gulod National Parks located in Ternate and Maragondon are proclaimed as natural parks, part of Ternate are military reservation, and Corregidor, Caballo (Fort Hughes), Carabao, Limbones, Sta. Amalia, El Fraile (Fort Drum), La Monja, Balot Island and Island Cove (PuloniBurunggoy) are named islands in Cavite. Unclassified land includes the Tagaytay ridges with slope greater than 50%, Magallanes forest land and parts of Maragondon (Figure 2.4).

Mineral Resources

The upland part of Cavite contains volcanic materials, tuff, cinders, basalt, breccias, agglomerate and interbeddings of shales, and sandstones in the soil. The dormant and active volcanoes (Taal) are within this volcanic area and have been the sources of volcanic materials which form the Tagaytay Cuesta. The drainage systems are deeply entrenched in the tuffs, eroding thin interbedded sandstones and conglomerate which are the source of little resources of sand and gravel in the larger stream. Adobe stone quarries also flourish in tuff areas. Meanwhile, in the lower part of Cavite, mostly coastal, marl and conglomerate can be found. Igneous rocks are prominent in the high, mountainous regions of western Cavite.

Specifically, the City of Bacoor and municipalities of General Mariano Alvarez, Tanza and Ternate have andesite and basalt; Cities of Dasmariñas and General Trias and municipalities of Indang, Maragondon, and Naic have sand gravel; and Magallanes has clay.

Corregidor Island
Source: https://jonnymelon.com/corregidor-tour/

Table 2.4 *Mineral Resources, Province of Cavite; 2018*

City/Municipality	Mineral Resources
City of Bacoor	Andesite, Basalt
City of Dasmariñas	Sand and Gravel
City of General Trias	Sand and Gravel
General Mariano Alvarez	Andesite, Basalt
Indang	Sand and Gravel
Magallanes	Clay
Maragondon	Sand and Gravel
Naic	Sand and Gravel
Tanza	Andesite, Basalt
Ternate	Andesite, Basalt

Source: CALABARZON Mining and Minerals Industry Profile – Mines and Geosciences Bureau IV-A

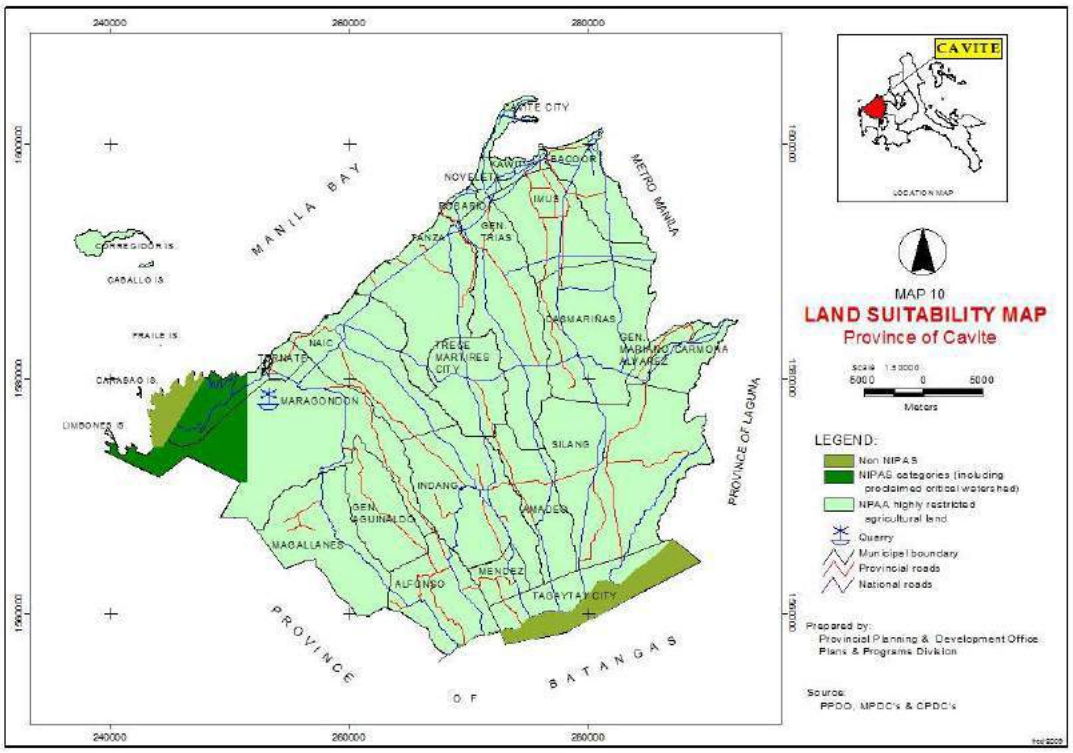

Figure 2.3 *Land Suitability Map of Cavite*

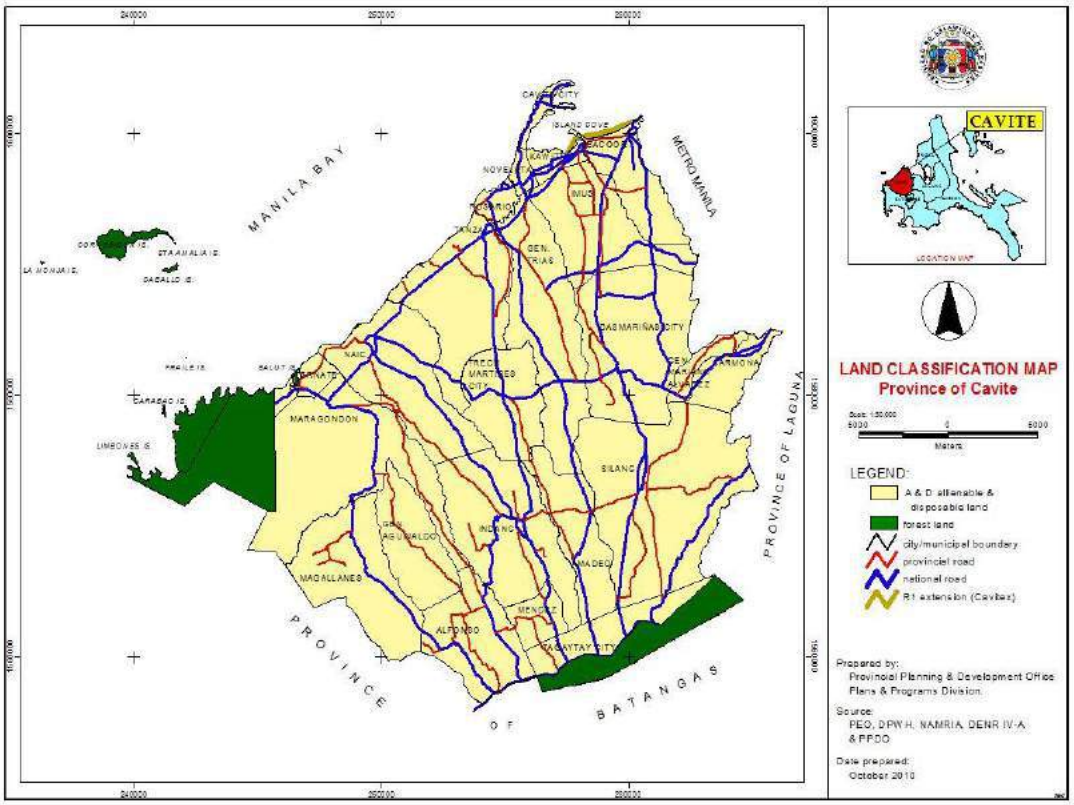

Figure 2.4 *Land Classification Map of Cavite*

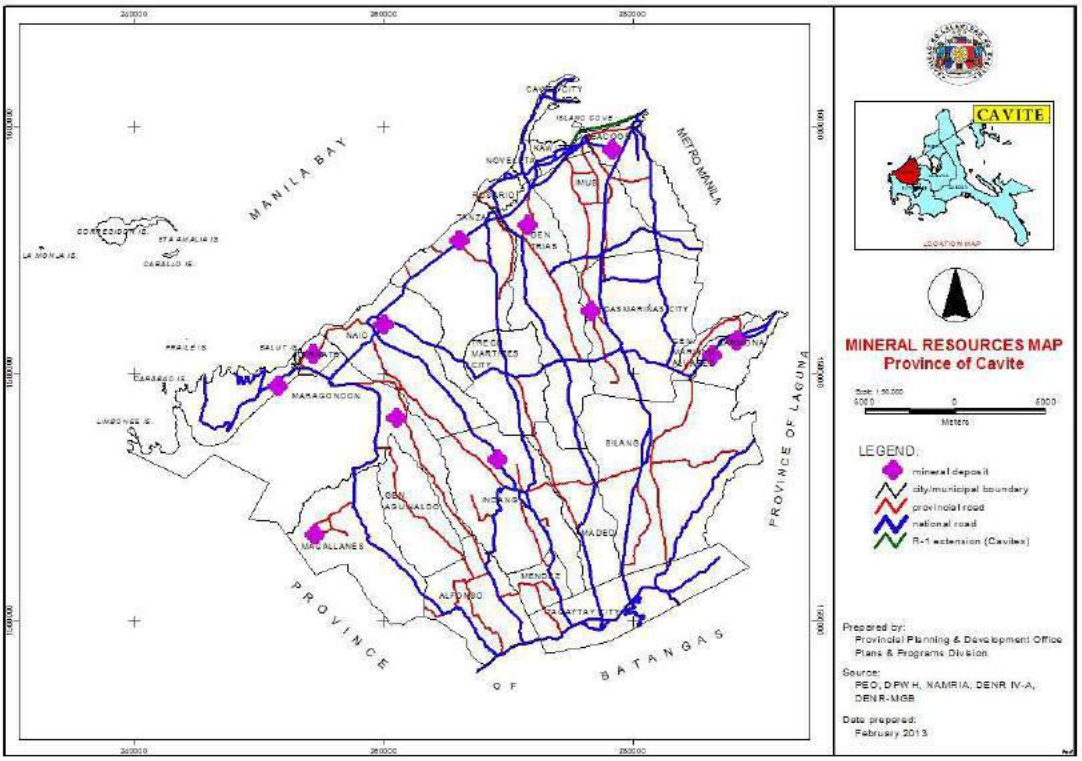

Figure 2.5 Mineral Resources Map of Cavite

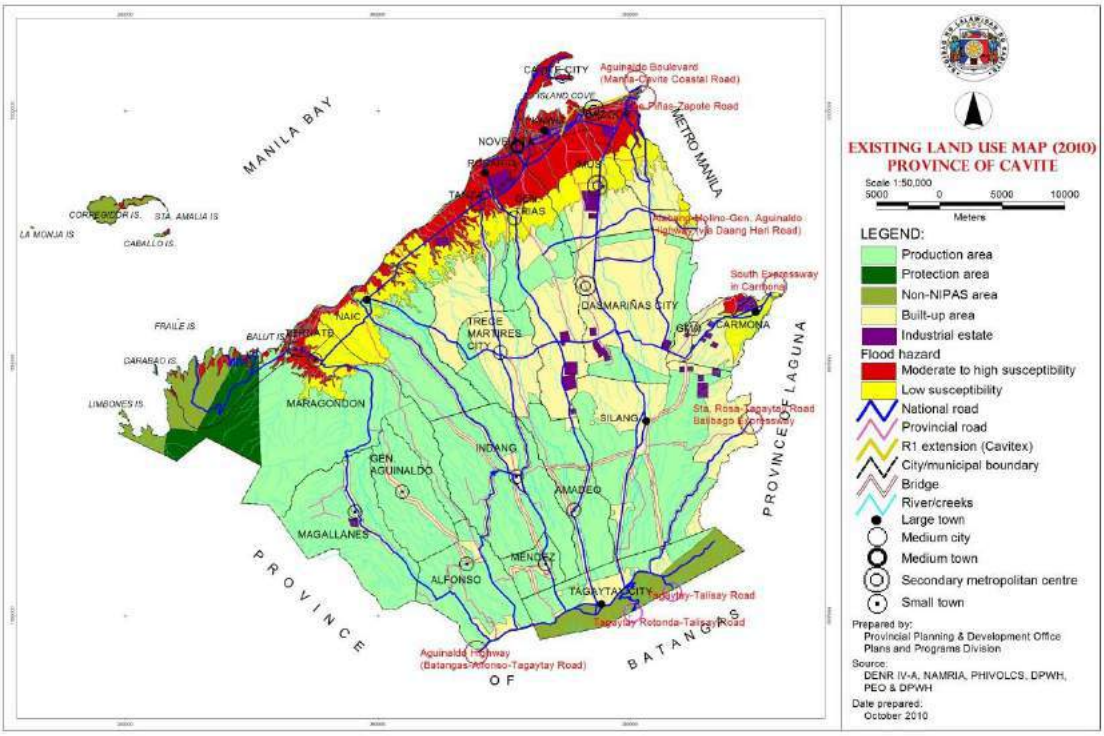

Figure 2.6 Existing Land Use Map of Cavite

Coastal Resources

Cavite boasts a stretch of about 122.574 kilometers of shoreline. It is found along Cavite City, City of Bacoor, Kawit, Noveleta, Rosario, Tanza, Naic, Maragondon and Ternate. The richness of Cavite's coastal resources paved the way for our recognition as a major producer of oysters and mussels. The fisherfolks are also active producers of sugpo/bangus. On the western coastlines lie the breathtaking beaches with pale gray sand. Thus, the coastal resource of the province contributes to the economic activities related to fishery and tourism.

Coral Reefs

Coral reefs are colonies of tiny living animals found in marine waters that contain few nutrients. It is commonly found at shallow depths in tropical waters and grow best in warm, shallow, clear, sunny and agitated waters. It delivers ecosystem services to tourism, fisheries, and shoreline protection. It also serves as home to marine life.

As of 2013, the Department of Environment and Natural Resources Region 4A – CALABARZON had mapped a total of 19.26 hectares of coral reef areas in Sitio Pinagkainan and Patungan, Barangay Sta. Mercedes, Maragondon, Cavite. Sitio Pinagkaingan, located in the eastern part of Limbones cove opposite Carabao Island, has a 34 percent live coral cover dominated by non-acropora corals (32.60%) and a small population of Acropora corals (1.40%).

In Sitio Patungan Munti, a slightly sloping ground and good water visibility at 30 ft. depth, has about 32.76% live coral cover where the "staghorn" corals (20%) are most seen. About 40 percent of the species were members of the two biggest families, the *Pomacentridae* and *Labridae*. A school of fusiliers (*Caesio* spp.) were also observed.

In Santa Mercedes Fish Sanctuary, coral reefs found are of families Acroporidae, Alcyoniina, Agariciidae, Caryophyllidae, Euphylliidae, Paviidae, Fungiidae, Meandrinidae, Montraeidae, Mussidae, Pectiniidae, Pocilloporidae, Poritidae.

Coral Reefs in Limbones Cove

Image source: www.choosephilippines.com *(Photos by: Mike Ajero)*

Mangroves

Mangroves are trees or shrubs that grow in the tropical coastal swamps that are flooded at high tide. Mangroves typically have numerous tangled roots above ground and form dense thickets.

Mangroves provide ecological and socio-economic importance in terms of protection of shoreline and coral reefs, nursery for fishes, shrimps, crustaceans and mud crabs, food and sanctuary for marine life, potential eco-tourism sites, protection for reclaimed land and wind breaker during typhoons.

As of May 2015, Cavite has a total of 195.893 hectares of mangrove areas. These mangrove areas are based on the Bio-ecological assessment of Department of /environment and Natural Resources – Manila Bay Coordinating Office (DENR-MBCO) Region IV-A conducted on November 2010 which is about 88.47 hectares located at City of Bacoor, Noveleta, Cavite City, Kawit and Rosario. The mangrove rehabilitation project is established from 2001 to 2015. Around 102.086 hectares of mangrove areas are planted in the last ten (10) years.

The species of Mangroves found in the province are:

1. Bakawan Babae (R. mucronata)
2. Bakawan Lalake (Rhizophora apiculata)
3. Bakawan bato (R. stylosa)
4. Api-api (Avicennia officinales)
5. Bungalon (A. marina)
6. Piapi (A. lanata)
7. Pagatpat (Sonneratia Alba)
8. Pagatpat baye (S. ovata)
9. Pedada (S. caeolaris)

Table 2.5 ***Existing mangrove and mangrove rehabilitation areas; Province of Cavite: May 2015***

Location	Assessed Mangrove Areas (2010) in ha.	Mangrove Rehabilitation Plantation (ha.)	Existing Mangrove Areas (ha.)
City of Bacoor	1.08	16.448	17.528
Kawit	29.17	33.528	54.800
Cavite City	27.42	4.200	31.620
Naic		1.000	1.000
Maragondon		1.000	1.000
Ternate		1.291	1.316
Tanza		1.000	1.000
Noveleta	27.28	42.619	83.109
Rosario	3.52	1.000	4.520
Total	**88.47**	**102.086 (Old growth is at 48.413)**	**195.893**

Source: PENRO - Cavite

Freshwater Resources

Freshwater is one of the most valued natural resources. Effective management to ensure its sustainable source is very important and is a primary concern of the government.

Surface Runoff

Surface runoff is water from rain, or other sources that flows over the land surface, and is a major component of the water cycle. Runoff that occurs on surfaces before reaching a channel is also called overland flow. A land area which produces runoff draining to a common point is called a watershed.

There are six major river watersheds in Cavite such as:

1. Bacoor River Watershed
2. Imus River Watershed
3. San Juan River Watershed
4. Cañas River Watershed
5. Labac River Watershed
6. Maragondon River Watershed

These rivers are known to have various tributaries passing through the different municipalities of the province (Table 2.6). These rivers and tributaries generally have a flowing direction from the highlands of Tagaytay City going to Manila Bay with stretches from the City of Bacoor up to Municipality of Ternate.

Water source, especially in the upland areas are abundant due to numerous natural springs, waterfalls and rivers. These have become beneficial among domestic, tourism, and industrial users. These include Balite Spring (Amadeo), Saluysoy Spring (Alfonso), Matang Tubig Spring (Tagaytay City), Malakas Spring (General Aguinaldo), and Ulo Spring (Mendez).

The province is also endowed with waterfalls such as Palsajingin Falls (Indang), Balite Falls (Amadeo), Malibiclibic Falls (Gen. Aguinaldo), Talon-Butas Falls (Gen. Aguinaldo), Saluysoy Falls (Alfonso) and Tala River (Gen. Aguinaldo). Nowadays, these God-given natural wonders are being utilized for recreational and leisure activities like picnics and gatherings.

Table 2.6 ***Major Rivers of Cavite***

Name	Length (km)	Point of Origin	Drainage Location
1. Bacoor River	12.3	Pintong Gubat, Molino passing Tanzang Luma, Salinas and Panapaan	Bacoor Bay
2. Imus River	38.4	North of Tagaytay passing Balite, Sabutan, Biga, Silang, Palapala, City of Dasmariñas, Pasong Bayog, San Agustin and connects to Pasong Bayog passing Salitran, Baluctot, Anabu II & Anabu I going to Tanzang Luma, Palico, Imus down to Salinas and Mabolo, Bacoor toward drainage. Tributaries which started from Bucal going to San Agustin join/connect Imus River in Pasong Bayog. Tributaries found in Baluctot also drain at Imus River.	Bacoor Bay
3a. San Juan River	39.0	Maitim, Amadeo passing Maitim, Lalaan I, Silang, Dagatan, Banaybanay, Calubcob, Panungyanan, Javalera, Biclatan, Manggahan, Jaime Baker; Buenavista, Pasong Kawayan, Bacao, Gen. Trias; Sta. Rosa, Noveleta and Putol, Kawit. Tributaries are at Bucandala and Panamitan.	Bacoor Bay Kawit
3b. Alang-Ilang River		Pasong Camachile River which started from Santiago passing San Gabriel connects with San Juan River; San Jose, City of Dasmariñas converging with San Juan River at Bacao, Gen. Trias	
4. Cañas River	38.9	From Kaybagal, Tagaytay City passing Loma, Amadeo going to Polanan River, San Agustin, Gregorio, Osorio, Lucbanan, Conchu, Inocencio, Trece Martires City; Alingaro, Gen. Trias passing Lubluban River, Santol, Bucal to Julugan, Tanza. Also, from Tagaytay City going to Salaban, Amadeo; Balagbag, Mahabang Kahoy, Limbon, Alulod, Indang and connects to Paradahan, Tanza Other tributaries are found in Buna Lejos, Limbon connecting in Alulod.	Manila Bay Julugan, Tanza
5. Labac River	30.5	Two contributory rivers located in the upland area. Starting from Buna Lejos, Indang passing Buna Cerca to Calumpang River going to Palangue, Naic to Kay-alamang River passing San Roque down to Labac River. Patutong Malaki, Tagaytay City passing Habulin River, Barangays II & III, Mendez going to Kayquit, Indang straight to Banaba Cerca going to Malainen Bago, Naic	Manila Bay
6.Maragondon River	35.6	Multi-sources Banaba Lejos passing Pantihan I & II. Tributaries are: Habulin River passing East Tambo to Banaba Lejos; From Palocpoc passing Lumampong and Banaba Lejos; Magay River to Maragondon River; Narvaez River passing Tabora to Maragondon River; Matagbak Buruhan River passing Sinaliw na Munti and Sinaliw na Malaki; Aliang River in Magallanes starting from Kaytitinga joined Narvaez River passing Tabora;Another river (unnamed) from west of Kaytitinga and Aliang River passing Magallanes and joined Tabora to Maragondon River	Manila Bay Ternate

Groundwater Resources

The groundwater is one of the best sources of fresh water for human and animal consumption. By definition, groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers.

The natural ground elevation or terrain affects the amount of ground water in an area, as well as the water extraction demand depending on industrial and residential demand.

The huge number of deep wells in the province has become a major source of concern about the decreasing amount of groundwater resource in Cavite. The towns of Naic, Tanza and Ternate and the cities of Dasmariñas, Bacoor, Imus and Gen. Trias highly depend on artesian wells. These have become their major source of water. These have caused the salt water intrusion in the aquifers due to over extraction of water. In a study made by the Japan International Cooperation Agency (JICA), the groundwater in Cavite is depleting at a rate of 1-meter water level decrease per year. In the upland areas of the province, groundwater is tapped mainly for domestic use through local water supply systems.

Based on the geological studies in Cavite, most of the ground water is stored in the pyroclastic rock reservoir and little in the volcano and clastic rock. Potable water is not reported in the near shore due to the presence of alluvium deposits which may be brackish and saline and are not safe for drinking and other domestic use. Another source of groundwater is called infiltrated rainfall which serves as the direct source of most near surface aquifers. Inflow from surface water reservoir and irrigation water also contributes to the ground water.

Freely-flowing wells occur in the 30-meter elevation of Southern Tanza and in the lower portions of near shore Naic and Ternate while in the City of Imus, it is at the elevation of about 15 meters.

Climate

Cavite has two pronounced seasons, dry from November to April and wet on the rest of the year. The following tables show the climatological report of Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) from its Sangley Point Observation Center in Cavite City.

The hottest temperature is observed in the month of May while it is coldest in January. Heaviest rains are experienced in the month of July and there is almost no rain on the onset of the year in April.

Table 2.7 *Monthly Average Temperature and Rainfall, Cavite City: 2018*

Month	Mean Temperature (ºC)	Rainfall (mm)
January	27.9	16.4
February	28.5	0.8
March	28.9	105.8
April	30.8	0.2
May	32.0	20.0
June	29.1	723.0
July	28.2	757.3
August	28.9	427.2
September	29.2	194.7
October	30.0	72.8
November	29.5	13.7
December	28.2	132.9
Annual	**29.3**	**2,464.8**

Source: Philippine Atmospheric, Goephysical and Astronomical Services Administration (PAGASA) Sangley Point Observation Center, Cavite City

Table 2.8 *Monthly Relative Humidity and Cloudiness, Cavite City: 2018*

Month	Relative Humidity (%)	Cloudiness
January	77	6
February	77	5
March	74	4
April	69	4
May	69	5
June	82	7
July	84	7
August	82	7
September	81	6
October	74	5
November	73	5
December	78	6
Annual	**77**	**6**

Source: Philippine Atmospheric, Goephysical and Astronomical Services Administration (PAGASA) Sangley Point Observation Center, Cavite City

Natural Hazards and Constraints

There are eight identified hydro meteorological and geological hazards in Cavite. These are:

1. Flooding (river overflow and inland)
2. Storm surge
3. Rainfall induced landslide
4. Earthquake induced landslide
5. Ground shaking
6. Liquefaction
7. Tsunami
8. Ground rupture

The entire province is generally susceptible to ground shaking. A total of 125,756 hectares of Cavite's total land area covering around 90% of the barangays are highly susceptible. There are towns in Cavite that are more susceptible to hazards than the others, vulnerable at around 7 of the 8 hazards are the towns of Naic and Tanza. It can also be observed that the town of

Magallanes is generally the least susceptible to hazards among all towns in the province (Table 2.9).

Around 298 barangays of Cavite, 35.9 percent of all barangays, are considered highly susceptible to flooding and storm surge, 231 of them are located along the coastal areas. The more than 320,000 inhabitants of those areas are considered living in disaster prone areas.

Table 2.9 ***Number of barangays by type of hazards; Province of Cavite***

City/Municipality	Flooding	Storm Surge	Rainfall Induced Landslide	Earthquake Induced Landslide	Ground Shaking	Liquefaction	Tsunami	Ground Rupture
1st District								
Cavite City	All	11			All	All	All	
Kawit	All				All	17	16	
Noveleta	All	5			All	9	5	
Rosario	All	8			All	18	10	
2nd District								
City of Bacoor	55				All	32	21	
3rd District								
City of Imus	38				All	2		
4th District								
City of Dasmariñas	11				All			
5th District								
Carmona	1				All			3
Gen. Mariano Alvarez					All			
Silang			6		All			4
6th District								
Trece Martires City					All			
Amadeo					All			
City of Gen. Trias	7				All			
Tanza	26	9			All	10	14	
7th District								
Alfonso					30			
Tagaytay City			11		31			
Gen. E. Aguinaldo					5			
Indang					All			
Magallanes								
Maragondon	3				13			
Mendez			4		All			
Naic	8	3			3	5	7	
Ternate	8	2	1		9	4		

Environmental Management

Cavite has the Cavite Environment Code (Provincial Ordinance No. 001-S-2008) that guides the province in formulating and implementing programs with the ultimate goal of safeguarding and conserving the land, mineral, marine, forest and other natural resources of the province. In each aspect of environmental management, Cavite also enacted specific ordinances in support of the Environment Code (Table 2.10).

Table 2.10 ***Legislations on environmental management; Province of Cavite: 2002-2017***

Ordinance/ Resolution No.	Year	Title
004	2002	An Ordinance prohibiting the smoking and selling of cigarettes in all public and private primary and secondary schools and within a radius of 100 meters from the school compound, premises and providing penalties for violations thereof
001	2003	An Ordinance prohibiting the improper disposal of used oil generated from automotive and industrial lube oil and petroleum sludge, providing penalties for violation thereon and for other purposes
004	2005	An ordinance to curtail illegal activities of professional and illegal squatters in the province of Cavite

Table 2.10 continued…

Ordinance/ Resolution No.	Year	Title
007	2005	An Ordinance prescribing safety measures in the refueling at any gasoline satiation within the territorial jurisdiction of the Province of Cavite and providing penalties for violation thereof
005	2006	An Ordinance regulating the operation of all junkshops and other similar business establishments and individuals engaged in buying and selling of metals with monetary value within the province of Cavite and for other purposes
004	2007	An Ordinance on the establishment of animal quarantine checkpoints for foot and mouth disease and other zoonotic diseases at strategic entry points in the Province of Cavite and imposing fees thereof
001	2008	Cavite Environment Code
005	2011	An Ordinance adopting the National Code on Sanitation in the Province of Cavite
001	2012	An Ordinance for the implementation of anti-dengue campaign at the barangay level
003	2012	An Ordinance adopting the Manila Bay Oil Spill Contingency Plan
007	2012	An Ordinance prohibiting, regulating, prescribing certain uses of plastics for goods and commodities that end up as residual wastes and promoting the use of eco-bags and other environment-friendly practices as an alternative and providing penalties for violations thereof
026	2012	An Ordinance regulating cigarette smoking within the Provincial Capitol compound of Cavite and providing penalties thereof
2013-007	2013	An ordinance establishing the "Greening Program" within the province of Cavite
2013-008	2013	Water Consumers Protection Ordinance of Cavite
2013-015	2013	An ordinance creating the Water Quality Management Are (WQMA) Governing Board for Imus-Ylang-ylang-Rio Grande River pursuat to DENR Administrative Order no. o2, Series 2013
2013-021	2013	An ordinance amending certain Provisions of Provincial Ordinance No. 007-2012 otherwise known as an Ordinance Prohibiting, Regulating and Prescribing certain uses of Plastics for Goods and Commodities that end up as Residual Wastes and promoting the use of Eco Bags and other environment friendly practices as an alternative and providing penalties for violation thereof
061	2014	An ordinance establishing the Provincial Clean Air and Anti-Smoke Belching Program and appropriating funds and providing fines and penalties thereof
129	2015	An ordinance requiring all car wash facilities operating within the territorial jurisdiction of the province of Cavite to install septic tanks in their respective premises and providing penalties for violations thereof
167	2017	An ordinance prohibiting the littering of solid wastes in the province of Cavite and providing penalties for violation thereof

Solid Waste Management

Management of solid waste is a major environmental concern of the government. The Republic Act 9003 stipulates the law on proper ecological disposal of solid waste, which is doing the least harm to the environment. In support of this, the provincial government has enacted Executive Order No. 29 which requires all cities and municipalities of the province to establish waste reduction and recovery schemes and to convert their open dumpsites to controlled ones. This is complemented by Provincial Ordinance No. 007-2012 that regulates the use of plastics and promotes the use of environmentally friendly packaging and practices.

Pursuant to Republic Act No. 9003 or the Ecological Solid Waste Management Act, the Provincial Solid Waste Management Board was also created.

Solid wastes are collected and disposed to either sanitary landfills or managed open dumpsites. At present, the province owns and uses 147 units of operational garbage trucks, compactors and mini dump trucks for its garbage collection system with capacities of 10/8 sq.m. and 4 sq.m., respectively. The disposal activities also employ around 529 people acting as garbage collectors, street cleaners and office support staff.

Table 2.11 shows the frequency of collection of solid wastes in each town as well as their type of disposal system.

Table 2.11 *Frequency of garbage collection and disposal system by City/Municipality; Province of Cavite: 2018*

City/Municipality	Frequency of Collection	Type of Disposal	Status of Compliance	Location of Disposal
1st District				
Cavite City	Main Roads/Market – Daily City Streets – twice a week	By Contract/Sanitary Landfill	-	San Mateo, Rizal
Kawit	Daily	By Contract/Sanitary Landfill	-	Laguna
Noveleta	Two trips/truck/day	By Contract/Sanitary Landfill	-	Calamba City
Rosario	Daily	By Contract/Sanitary Landfill	-	Suri, Calamba City
2nd District				
City of Bacoor	Daily	By Contract/Sanitary Landfill	-	Bay, Laguna
3rd District				
City of Imus	Barangay – once a week Market – daily	By Contract/Sanitary Landfill	-	City of Imus
4th District				
City of Dasmariñas	Daily	By Contract/Sanitary Landfill	Operating	Brgy. Salawag
5th District				
Carmona	Twice a week	By Contract/Sanitary Landfill	-	San Pedro, Laguna
Gen. M. Alvarez	Thrice a week	By Contract/Sanitary Landfill	-	Calamba City, Laguna
Silang	Once a week Public market – daily	By Contract/Sanitary Landfill	-	Suri, Calamba City
6th District				
City of Gen. Trias	Twice a week	By Contract/Sanitary Landfill	-	Calamba City, Laguna
7th District				
Amadeo	Thrice a week	By Contract/Sanitary Landfill	-	San Pedro, Laguna
Indang	Daily except Saturday	By Contract/Sanitary Landfill	-	Suri, Calamba City
Tanza	Twice a week	By Contract/Sanitary Landfill	-	Pilotage, San Pedro, Laguna
Trece Martires City	Daily	By Contract/Sanitary Landfill	-	Trece Martires City
8th District				
Alfonso	Twice a week	By Contract/Sanitary Landfill	-	Suri, Calamba City
Gen. Emilio Aguinaldo	Monday/Tuesday – Biodegradable Wednesday and Thursday – Non-biodegradable	By Contract/Sanitary Landfill	-	San Pedro, Laguna
Magallanes	-	By Contract/Sanitary Landfill	-	Pilotage, San Pedro, Laguna
Maragondon	Daily	By Contract/Sanitary Landfill	-	Pilotage, San Pedro, Laguna
Mendez	Five times a week	By Contract/Sanitary Landfill	-	Suri, Laguna
Naic	Once or twice a week	By Contract/Sanitary Landfill	-	San Pedro, Laguna
Tagaytay City	Daily	By Contract/Sanitary Landfill	-	San Pedro, Laguna
Ternate	Daily	By Contract/Sanitary Landfill	-	Pilotage, San Pedro, Laguna

Source: Solid Waste Management Division, Provincial Government Environment and Natural Resources Office