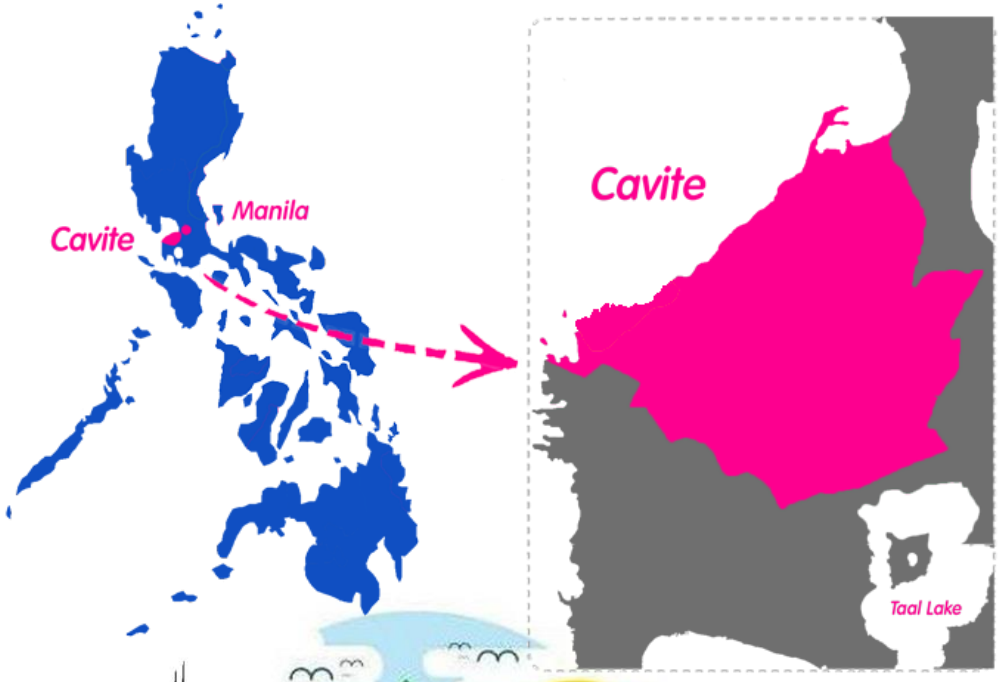
Chapter 2. Geo-Physical Environment

Geographical Location of Cavite

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. It is bounded by the provinces of Batangas in the south, Laguna in the east, Rizal in the northwest, Metro Manila and Manila Bay in the north, and West Philippine Sea in the west. Its proximity to Metro Manila gives the Province 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 in order to ensure the appropriate representation of the province in the congress. In the year 2009, by virtue of RA 9727, the province was divided into seven legislative districts. 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 District IV, 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.

By virtue of Presidential Decree 1163, Imus is the provincial capital but the seat of the provincial government is located at Trece Martires City.

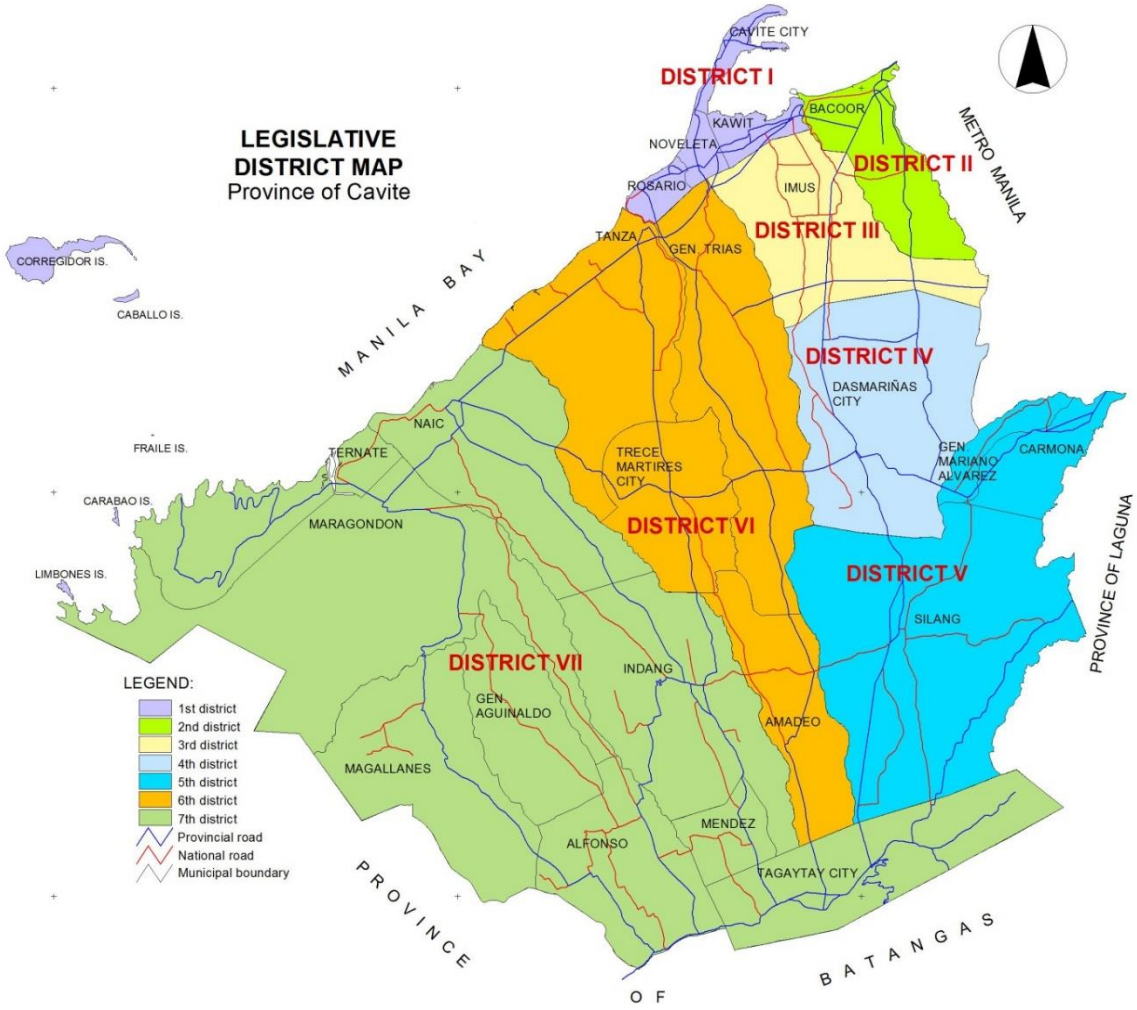


Table 2.1 Number of Barangays by City/ Municipality and Congressional District, Province of Cavite: 2016

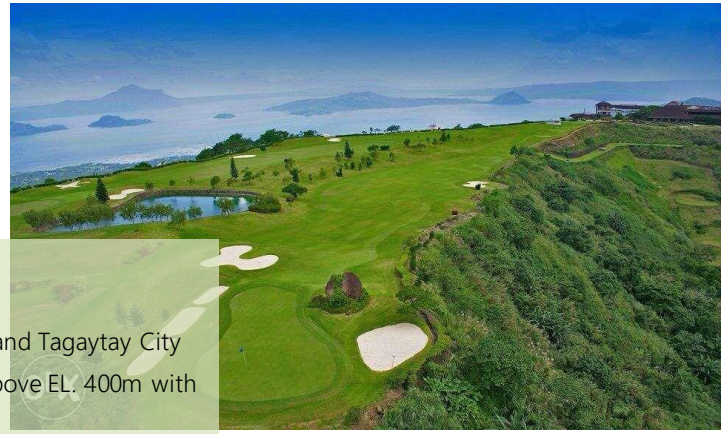
City/Municipality	Number of Barangays
1st District	
Cavite City	84
Kawit	23
Noveleta	16
Rosario	20
2nd District	
City of Bacoor	73
3rd District	
City of Imus	97
4th District	
City of Dasmariñas	75
5th District	
Carmona	14
Silang	64
Gen. M. Alvarez	27
6th District	
Trece Martires City	13
Amadeo	26
City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

Source: Provincial Planning and Development Office

Topography

Coastal Plain

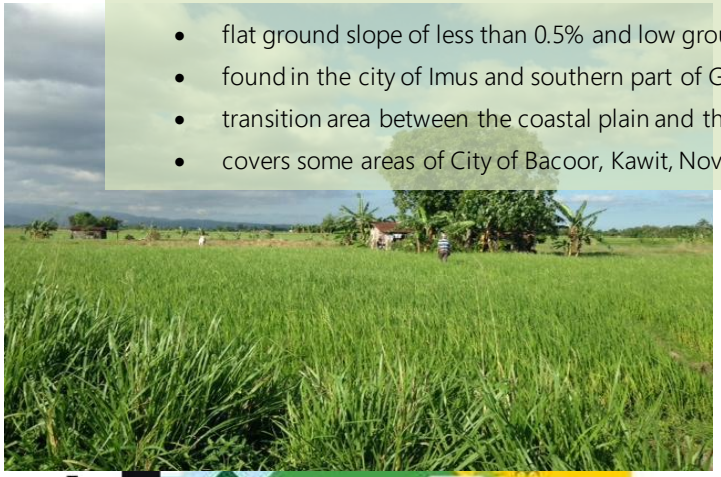
- lowest lowland area
- extremely low ground level of EL. 0m to EL. 2m compared to the high tide level of about EL. 0.8m from the Mean Sea Level (MSL).
- These are the city of Bacoor and municipalities of Kawit, Noveleta and Rosario.



Upland Mountainous Area

- found in Amadeo, Silang, Alfonso and Tagaytay City
- Situated at a very high elevation above EL. 400m with slopes of more than 2%.
- The Tagaytay ridge has a peak elevation of 650m.

Coastal and Alluvial Plains



- flat ground slope of less than 0.5% and low ground elevation of EL. 2m to EL. 30m.
- found in the city of Imus and southern part of General Trias
- transition area between the coastal plain and the central hilly area.
- covers some areas of City of Bacoor, Kawit, Noveleta, Rosario and Tanza

Central Hilly Area

- found on the mountain foot slope
- forms the rolling tuffaceous plateau
- includes steep hills, ridges and elevated inland valley
- characterized with ground elevation ranging from 30m to nearly 400m
- ground slope ranges from 0.5 to 2%
- Cities of Trece Martires City and City Dasmariñas, and the municipalities of Indang and Silang have this kind of topography.

Geology

Soils

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.

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 rootcrops.

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 tuffaceaous 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 Alang-ilang River at Noveleta.

The type of soils that dominate the upland areas are 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 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 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 substratum of marine conglomerates which are found at Sta. Mercedes in Maragondon and in some coastlines of Ternate.

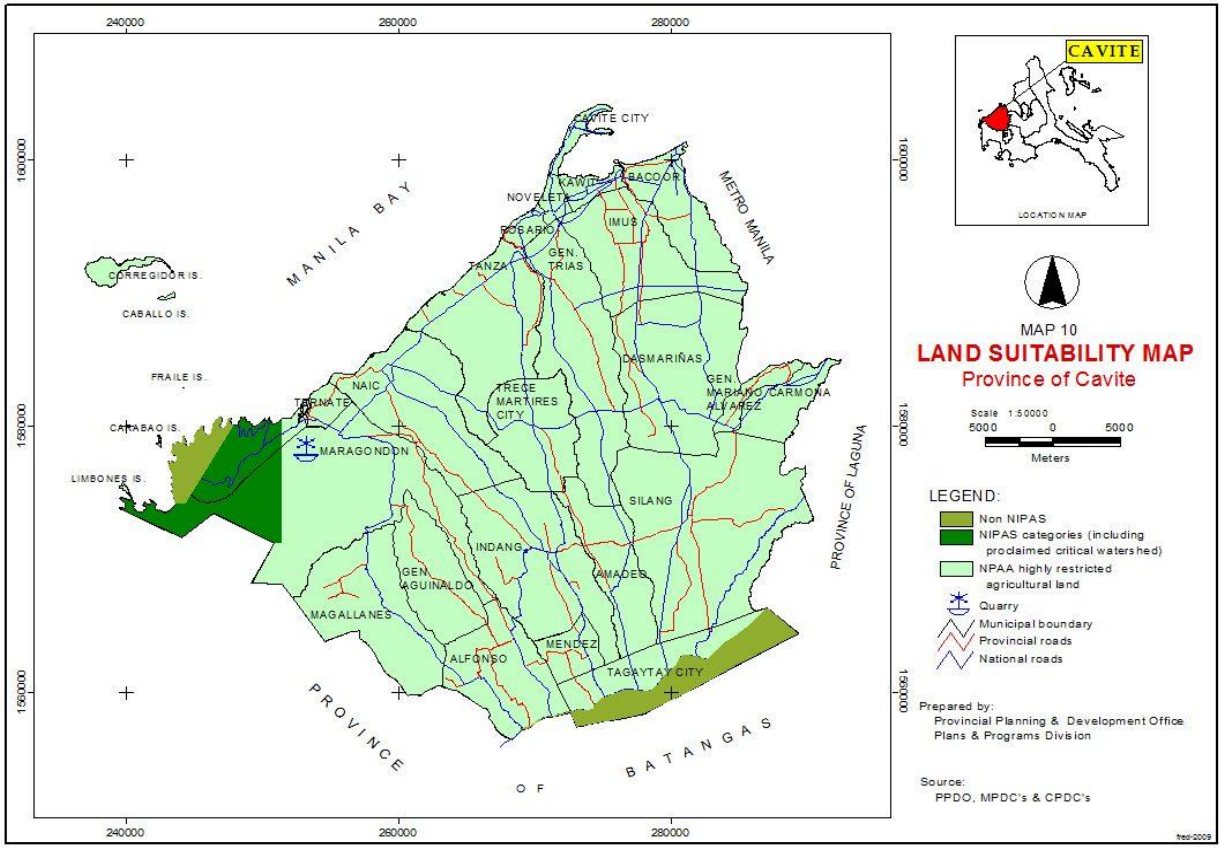
Land Suitability

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 in terms of their suitability for defined uses.

Majority of the provincial land are defined for highly restricted agricultural use. The lowland areas covering the municipalities of Imus, Bacoor, General Trias, portions of Tanza, Naic and Rosario are primarily suitable for irrigated rice/fresh water fishponds. The central part of the Province covering mainly the municipalities of Dasmariñas, greater 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 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 are considered as National Integrated Protected Areas System (NIPAS) land which cannot be altered from its natural habitat.

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



Tagaytay Ridge at Tagaytay City

Land Resources

Land Classification

The land resource of the province is at 142,706 hectares. This is categorized into two (2): Alienable and Disposable (A&D) Land and Forest Land. The Alienable and Disposable land accounts for 129,391 hectares or 90.67% share to total land resource where economic activities (Agriculture – 55.24% share to A&D) and human settlements (44.76% share to A&D) occur. On the other hand, forestland which is 9.33% or 13,315 hectares shared to total is presumed that land resource is preserved to maintain the ecological balance in the province categorized as Classified Forest (Protected Areas, Military Reservation and Named Islands) and Unclassified Forest (Mountains) (Table 2.2).

Table 2.2 Land Classification, Province of Cavite: 2011-2020

Land Classification	Area (Has.)	% Share	% Share to Classification
A. Alienable and Disposable	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 Land	13,315.00	9.33	
1. Classified	5,357.36	3.75	40.24
a. Protected Areas/Natural Park	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**	**100.00**	

Source: Provincial Development and Physical Framework Plan 2011-2020

The built-up areas 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.

The production land, on the other hand is the area were agricultural activities and food productions takes place.

The forest lands are those that have either national proclamation to become forest reservations. Likewise are those lands that are not suitable for any particular use. This may be a factor of topography and elevation.

For Cavite, we have the Sangley Point, Corregidor Island and the Mts. Palay-palay and Mataas na Gulod Protected Landscape under the classified land. Unclassified land includes the Tagaytay ridges.

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 is referred as dry land, is the solid surface of the Earth that is not permanently covered by water. Land 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% of the CALABARZON's land area. This is relatively small considering that the Region is only comprised of five provinces. The land area of Cavite is equivalent to only 0.48% of the total land area of the Philippines which is 299,404.00 hectares. The municipalities of Maragondon and Silang have the biggest land areas comprising 16,549 hectares and 15,641 hectares, respectively while the municipality of Noveleta has the smallest land area as with 541 hectares or 0.38% of the provincial total land area.(Table 2.3).

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 inter-bedded sandstones and conglomerate which are the sources of little reserves of sand and gravel in the larger stream. Adobe stone quarries also flourish in the tuff areas.

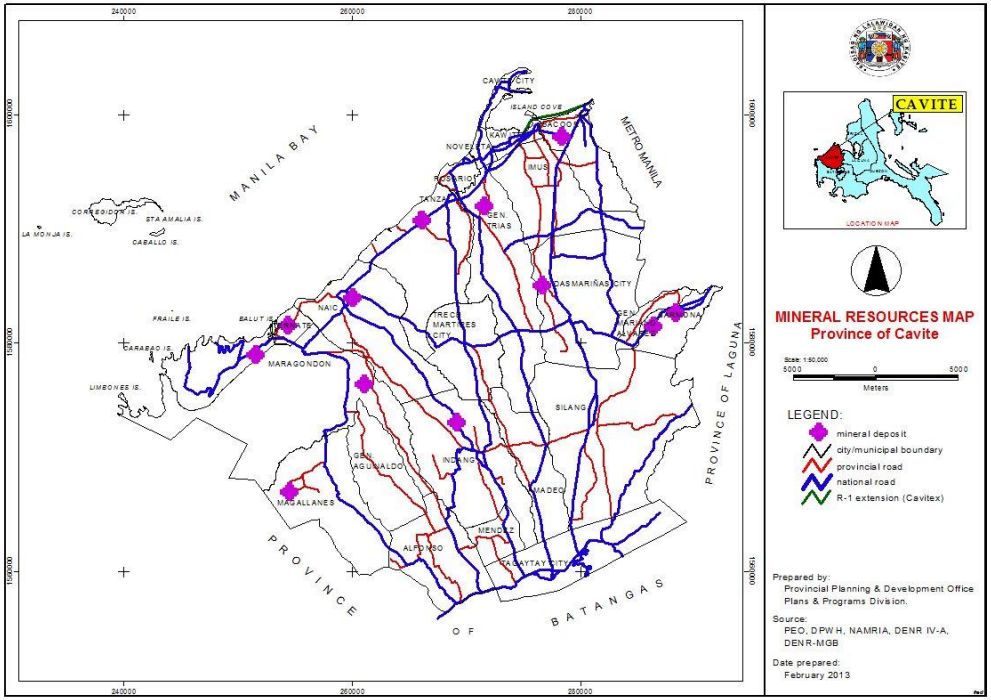


Table 2.3 Land Area by City/Municipality, Province of Cavite: 2016

City/Municipality	Land Area (Hectares)	% 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
Silang	15,641	10.96
Gen. M. Alvarez	938	0.66
6th District		
Trece Martires City	3,917	2.74
City of Gen. Trias	11,768	8.25
Tanza	9,630	6.75
Amadeo	4,790	3.36
7th District		
Tagaytay City	6,615	4.64
Alfonso	6,460	4.53
Gen. Emilio Aguinaldo	5,103	3.58
Indang	8,920	6.25
Magallanes	7,860	5.51
Maragondon	16,549	11.60
Mendez	1,667	1.17
Naic	8,600	6.03
Ternate	4,350	3.05
Total	**142,706**	**100.00**

Source: Provincial Development and Physical Framework Plan 2011-2020

Table 2.4 Mineral Resources, Province Of Cavite: 2016

City/Municipality	Mineral Deposits	Location
Alfonso	Gravel, Sand	
Carmona	Gravel, Sand, Clay Gravel, Sand	Mabuhay, Ulong Tubig
Gen. Aguinaldo	Adobe, Boulders	Batas-Dao, Lumipa Kaymisas &Lumipa
Kawit	Black Sand	San Sebastian
Ternate	Gravel and Sand Boulders Banda-Banda	Bucana, San Jose, San Juan, Poblacion, Sapang
Magallanes	Gravel Deposit	Ramirez, Urdaneta
Maragondon	Manganese, Iron Gravel, Sand	Tulay, Mabato Caingin
Naic	Sand	
Noveleta	Salt	San Rafael
Silang	Sand	Tibagan, Malaking Ilog, Matindig

Source: Cavite Environmental and Natural Resources Office

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. Black sands are found in Kawit. Noveleta has its own salt products. Magallanes have gravel deposits while reserves of sand and gravel materials are found in Alfonso, Carmona, Gen. Aguinaldo, Naic, Ternate, Maragondon and Silang. Adobes are abundant in Maragondon and serves as a good source of rocks and boulders (Table 2.4).

Coastal Resources

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. The people in the province also earns income from mangrove products such as source of planting materials for sale, fish, wood for fuel, shellfish, mud crabs and other crustaceans. Mangroves can be found in the coastal towns of Maragondon, Ternate, Naic, Tanza, Rosario, Noveleta, Kawit, Cavite City and Bacoor City.

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 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 20014 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 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

Surface Run-off

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.

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 and the
6. Maragondon River Watershed

Table 2.6 Major Rivers of Cavite

Name of Rivers	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 table shows 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 January (Table 2.7).

Table 2.7 Monthly Average Temperature and Rainfall, Cavite City: 2015

Month	Average Temperature (°C)	Rainfall (mms)
January	26.6 °C	0.4
February	27.4 °C	3.3
March	28.6 °C	7.2
April	30.6 °C	1.2
May	31.6 °C	84.5
June	31.1 °C	321.4
July	29.5 °C	523.4
August	29.7 °C	296.8
September	29.7 °C	460.3
October	29.4 °C	212.9
November	29.6 °C	27.8
December	28.2 °C	163.2
	29.3 (Average)	**1,734.3 (Total)**