

Environmentally Critical Areas

The environmentally critical areas in the municipality under Presidential Proclamation No. 2146 are the NIPAS areas, timberlands, areas that are prone and vulnerable to natural hazards, areas with critical slopes, areas classified as prime agricultural lands and water bodies.

The Bulusan Volcano mountain ranges including Mt. Agoho and Mt. Jormajan on the northern section have the largest constrained area where there is overlapping of NIPAS lands, the permanent danger zone, pyroclastic flow hazard zones and areas with slope of 30%. Critical slopes can also be found in the Mt. Maraot Banwa in Cawayan, Tabon-tabon and Carrideo as well as in Salvacion adjoining Buenavista and San Isidro. Other areas of critical slopes are in Casini near the boundary with Matnog and in hilly areas in Batang, Gumapia and Tongdol. The areas in the lower elevation at the valley floor that are prone to flooding during heavy rains are also considered under this category. The banks or easement of rivers and creeks are part of water bodies and are therefore constrained areas.

Timberlands not yet declared as alienable and disposable lands in Tabon-tabon, Cawayan, Bolos and Liang with a total of 76.4970 hectares are also considered as constrained areas. Prime agricultural lands are the Network of Protected Agricultural Areas or Network of Areas for Agricultural Development (NPAA/NAAD) of Irosin that falls under ECA category. These are agricultural lands that are protected from any form of conversion so as to keep and preserve the highly suitable agricultural land for primary food crops. In this regard, the existing irrigated and potentially irrigable rice lands of 2,128.39 hectares of the municipality falls under this land resource category.

The total environmentally constrained area in the municipality is estimated to be 7,625.823 hectares which represents 51% of the total land area.

Current and Future Climate Risk

Historical and current extreme weather/climate event that have affected the municipality include El Nino-related droughts and La Nina- related floods. Irosin is also is exposed to tropical cyclones and associated maximal values of 24-hour rains and winds, particular during the northeast monsoon season from October to February. From the period 1948 to 2006, there were 33 tropical cyclones that crossed the Province of Sorsogon or an average of one tropical cyclone every two years. For the same period, the number of tropical cyclone which crossed the province and 100 kilometers from boundaries was 140 tropical cyclones or an average of five every two years. One of the most intense tropical cyclone that directly crossed the municipality was Typhoon Dinang (Lee) on December 25, 1981 with a peak intensity of 150 kilometer per hour winds.

In 2020, projected temperature increase are 0.8 °C during the month of December to February, 1.0 °C in the quarter from March to May, 0.8 °C during the 3-month period from June to August and 0.8 °C again from September to November. The highest increase in mean temperature is definitely during its warmest summer months. The projections for mean temperature increase in 2050 are quite higher with 1.8 °C, 2.2 °C, 1.9 °C and 1.7 °C in December to February, March to May, June to

August, and September to November respectively. Again, the highest projected increase is during the warmest months (MAM) as can be seen in Figure 5.

On the other hand, the projected increase in rainfall volume at 2020 climate change scenarios ranges from 2% in March to May to 23% in June to August. The middle values were projected at 13% in September to November and 19% in the quarter of December to February. Projected increase in rainfall Irosin in 2050 are higher with 11% in December to February, 20% in September to November, and 31% in June to August. The warm months of March to May will have a 12% decrease. A 19% increase in rainfall volume in December to February would most likely result to an increase of 200 mm rainfall volume in 2020.

Indicated in the results of extreme daily temperature- and rainfall- trends analysis are that the number of hot days and warm nights are increasing, with the number of cool days and cold night decreasing. Total rainfall shows an increasing trend, with also an increase in the number or frequency and intensity of extreme rain events. These indicate increasing maximum and minimum temperatures coupled with increasing rainfall and thus increasing flooding risk.

Risk Areas

The risk areas in the municipality are the slopes of Bulusan Volcano, the riverbanks, the catchment basin of Cadac-an River and the hills and mountains with steep slopes.

The active crater of Bulusan Volcano is located 7.5 kilometers north from the urban center and straddling the northeastern

boundary between barangay Cogon and the municipality of Bulusan. The volcano is part of the Bicol Volcanic Chain with a height of 1,559 meters and a base diameter of 15 kilometers. It is characterized as a stratovolcano formed inside a caldera. Eruption types of the volcano are caldera-forming which occurred 40,000 years ago, strombolian eruptions (1918-1919) and phreatic type (1918-1922, 1980, 2006-2007 and 2010-2011). The hazards associated with Bulusan Volcano are pyroclastic flows, lava flows, lahars and ash fall. A four-kilometer radius around the volcano is declared a permanent danger zone.

The pyroclastic flow hazard zone is about 1,632.72 hectares which encompasses the BVNP forest areas and reaches up to the built-up area of Cogon and Sito Talistison in Mapaso. On the other hand, the lava flow hazard zone overlaps the pyroclastic flow hazard zone and extends further up to five kilometers radius and includes the built-up area of Cogon, Mapaso and portions of the national highway. The lava flow hazard zone covers 2,855.87 hectares of mostly forest and agricultural use lands.

Lahar flows from 2006-2007 ash explosions are mainly confined to gullies at the slopes of the volcano which flows down to the dry creeks of Cogon, Gulang-gulang, Monbon, Mapaso and Patag. A lahar flow in October 2007 prompted the evacuation of 1,596 persons from near and downstream of the gullies. However, in a worst-case scenario of a cataclysmic eruption of Bulusan Volcano, the areas to be affected by lahar will cover the whole Irosin valley. In this scenario, lahar will inundate the urban areas as well as built-up areas of the rural barangays except for Cawayan, Bagsangan, Salvacion, Casini and Liang. Lahar will affect 4,372 hectares or 29% of the total land area.

Recent activities of Bulusan Volcano are phreatic or steam driven which results to explosion of ash, rock and volcanic materials. The area affected by ash fall is largely determined

by the volume of material ejected and the prevailing wind direction. An ash explosion in February 21, 2011 reached 3 kilometers high above the summit and ash blanketed areas to the southwest reaching as far as Masbate Island.

Irosin is listed by the MGB-DENR as among the 48 municipalities in the Bicol Region considered as geologically hazardous and highly prone to flooding and landslides. The municipality is usually affected by tropical storms and typhoons that pass through the Bicol Region. These events triggers landslides, flash floods, mudslides, widespread floods that together with high winds causes destruction to houses, buildings, roads, infrastructures and agriculture.

An estimated 792 hectares of land is frequently flooded. These are areas where heavy torrential rains of one to two days could bring about flooding. Moderate to strong typhoons could submerge these areas in 0.5 to 2.0 meters in flood waters for a few days to a few weeks. Development of urban settlements in these areas is not recommended. These areas are mostly confined to the valley floor near the convergence point of Cadac-an River, Monbon River and Buenavista River. Frequent flooding is also observed near the banks of creeks and rivers of the riparian system of the municipality. A flood assessment report indicates that 21 out of the 28 barangays are flood-prone, namely San Isidro, Salvacion, Batang, Monbon, San Juan, Bagsangan, Tabon-tabon, Sto. Domingo, Gabao, Bulawan, Tongdol, Gumapia, Carriedo, Buenavista, Macawayan, San Pedro, Patag and Mapaso. A recent flooding incident on January 10-11, 2011 triggered by torrential rains submerged 520 hectares of rice lands and prompted the evacuation of 2,180 persons. The earliest recorded flooding happened on December 24, 1933 when the Cadac-an River burst its banks and several people perished. A concrete river control was constructed in 1937 to keep the violent surge of the river from eroding the *poblacion*.

From the hazard maps of MGB-DENR, an additional 1,336 hectares

of lands are considered as occasionally to rarely flooded areas. These are areas that become inundated during moderate to strong typhoons. Flood depths vary from a few centimeters to one meter and floods may last from a few hours to a few days. The rarely flooded area nearly encompasses the whole of Irosin valley and there is no historical reference that flooding of such extent has occurred in the past.

Areas with high susceptibility to landslides are areas with high probability of occurrence of mass movements particularly rock and debris slides, slumps and debris flow. The crater walls surrounding the Irosin valley, the volcanic ravines and gullies of Bulusan Volcano and the very steep and nearly vertical slopes underlain by Tabon-tabon volcanic are rated high susceptibility areas and are unsuitable for urban land use.

Twenty-two out of the 28 barangays of Irosin have zones with landslide hazard and a total of 102 landslides were mapped. Barangays located at undulating hills and mountains have the highest number of landslide mapped where Mapaso has 11 landslide mapped, Salvacion has 15, Liang has 13, Casini has 6, Batang has 11, Gabao has 9 and Bagsangan has 7 landslide mapped. Five landslides were mapped in Patag, four each in Monbon, Bulawan, Cogon, Bolos, three in barangay Tongdol, two in Cawayan, and one each in San Isidro, Gulang-gulang, San Julian and Buenavista.

There are no known active faults traversing the municipality of Irosin. The most active fault in the area is the Masbate Fault located 45 kilometers southwest in Masbate and Ticao Islands. Another fault in the vicinity is the Northern Samar Lineament which is located southeast about 55 kilometers in Samar Island. The nearest fault is an unnamed fault traversing the Bicol Region that ends in Sorsogon Bay located just 30 north of the municipality. All faults in the area are in a northwest to southeast orientation. The Philippine Trench is 180 kilometers to the west at the Philippine Sea.

Recorded earthquake epicenters from 1600 to 2005 in the vicinity of Irosin are mostly clustered in the Masbate Fault and in San Bernardino Strait. Past earthquakes of significant strength include the 1954 magnitude 6.7 earthquake with epicenter in Sorsogon City which is 30 kilometers away. A magnitude 7.4 earthquake also occurred in 1943 with an epicenter at San Bernardino Strait about 35 kilometers away.

Environmental Conditions

The protected area or NIPAS area in the municipality is the Bulusan Volcano Natural Park located at barangay Cogon with an area of 1,045.71 hectares. The BVNP consists of montane and lowland forest in a mountain complex covering the municipalities of Irosin, Juban, Casiguran, Barcelona and Bulusan with a total area of 3,673.29 hectares. Biodiversity profile of the BVNP includes threatened bird species of Philippine Duck, Philippine Hawk-eagle, and Flame-breasted Fruit-Dove as well as restricted-range bird like Luzon Bleeding-Heart, Luzon Hornbill and others. Mammals that have been recorded include Philippine Brown Deer, Philippine Warty Pig and the threatened Giant Cloud Rat. Endemic herpetofauna include forest frogs, tree skinks and the threatened Sailfin Water Lizard.

The following data presented is the result of quadrant samplings in the barangays of Cogon, Monbon, Bagsangan and Patag during the Rapid Site Assessment conducted for BVNP. Of the 38 tree species identified 26 were of hardwood and 12 of softwood variety. The presence of high-density tree population can be accounted to the fact that they are located in higher

elevation level with extremely steep slope range. Another important finding is that there is a predominance of tree saplings in the undergrowth of which they have a 27% presence value rating. Of the 46% of the faunal inventory, the avifaunal population has the highest presence value of 52% while the amphibians have the lowest with 6%. Common: Few Abundance Ratio per specie is as follows: 42:58 for birds, 33:67 for mammals and 80:20 for reptiles. However, when Sighting Frequency is inter-faced with Abundance Level, the ratio is reversed to 46:54. Nonetheless, the faunal inventory is still of good account taking into consideration that the presence value of birds is high and they occupy the top-most position in the food-chain ladder and they are sensitive to ecological changes and thus useful as an ecological indicator.

Adjacent to the protected area are forest areas in alienable and disposable lands located in Cogon, Monbon, Bagsangan, Patag and Mapaso with an area of 313.41.25 hectares. Forest areas can also be found in Mt. Jormajan located in Bolos and Cogon and in the Mt. Maraot Banwa mountain ranges in Cawayan and Tabon-tabon in timberlands and alienable and disposable lands. The Mt. Jormajam forest cover is about 224.75 hectares while the Mt. Maraot Banwa forest is 790.14 hectares. The total area of non-NIPAS forest areas is 1,290.99 hectares. The old growth dipterocarp forests are nearly gone in these areas except for the residual regenerating second growth forests and forests under rehabilitation planted to mahogany, gemelina, acacia, narra and other tree species. Threatened endemics that occur in BVNP can be possibly found in these areas. The existing primary and residual forest vegetation in these non-NIPAS areas rationalizes forest protection.

The remaining forests are already at a risk from illegal tree cutting, slash and burn farming, conversion of forest lands into agricultural uses and indiscriminate extraction of minor forest products. These degenerate practices hasten the forest denudation and loss of biological diversity. It is most

important that these practices must be curtailed or stopped to prevent further degradation of the flora, fauna and soil composition of the municipality. Likewise, this upland ecosystem plays a great part in the air and water quality of the lowland ecosystem of the municipality.

Cadac-an River is the namesake of the Cadac-an Watershed which traverses Irosin, Juban and portions of Bulusan, Bulan and Casiguran with an estimated total area of 21,567 hectares. The Cadac-an watershed in Irosin covers 10,356 hectares or 69% of Irosin's land area. The watershed starts at the slopes of Bulusan Volcano and Mt. Maraot Banwa. The slopes to the east and south of Mt. Maraot Banwa as well as the hills of Casini and Salvacion drains to the watersheds of the municipalities of Sta. Magdalena, Matnog and Bulan. The easements of Cadac-an River, other major rivers, creeks and lakes with an approximate area of 257.75 hectares are also considered as protection lands.

The Irosin Caldera dominates the lowland ecosystem where various creeks, streams and rivers crisscross the sprawling valley floor. This ecosystem is classified into agricultural areas, built-up/urban areas and inland waters. The agricultural areas are divided into areas of sustainable land use, under-utilized land and over used lands. The agricultural production areas are mostly areas of sustainable land use planted to palay, coconut and other crops. The under-utilized lands are situated in the upper and lower river terraces suitable for irrigated rice lands but are planted to perennial trees and areas suitable to annual crops but are planted to coconut. The most common over-used lands are those areas with more than 18% slope suitable for production forests or should be maintained as forest but are planted with perennial crops.

The present attitude of farmers towards crop production is already depleting the soil quality. High yielding variety seeds that are dependent on a large quantity of inorganic fertilizers and pesticides are utilized thereby upsetting the

soil pH, fouling the air quality and contaminating the creeks and streams due to the over reliance to pesticides. Thus, even endemic fishes in the rice paddies, rivers and other inland waters are already gone. The mono-cropping practices and inappropriate farming technologies have aggravated further the already deteriorating state of the agricultural production areas.

In the built-up/urban areas the concentrations of human settlements, commerce, industry and public and private services are found. It is also the educational centers are situated as well as the seat of the governance of the municipality. This concentration of the human activity in the valley floor affects the lowland environment. It is a must that proper and appropriate waste disposal, farming practices and use of environmentally friendly products must be affected to negate the accumulation of pollution in the soil and water.

Coconut, woodland and rice are the prominent vegetation cover occupying 62%, 15% and 14% of the gross land area of the municipality respectively. Other agricultural crop is planted in 1% while grass/shrubs cover 2% of the total land area. A total of 94.52% of the municipality's land area or 14,168.04 hectares has vegetation cover.

Rice occupies the broad alluvial plains with an area of 2,194.25 hectares and is planted in 18 barangays and is mostly confined to elevation 19 to 70 meters in slope range 0 to 8%. Coconuts cover 9,426.20 hectares and can be found over the four points of the compass in 23 barangays up to elevation of 520 meters and in slope ranges of 0 to 50% and above. It must be noted that coconut is interspersed with other crops such as abaca, citrus, fruit trees, pili and other crops. Abaca, which was planted to 3,502 hectares in 2010 was decimated by bunchy top and mosaic virus infestation but patches of this crop are still present.

Woodlands cover 2,082.52 hectares and can be found in

elevations from 90 to 1,060 meters in slope range 18 to 50% and above. Woodland occupies a significantly lesser area than documented forest areas considering the presence of grasslands and barren lands at the slope of Bulusan Volcano. Grass/shrubs are those found at the slopes of Bulusan Volcano, in areas razed by forest fires and in abandoned slash-and-burn lots with a total area of 356.07 hectares in elevations 80 to 1,250 meters and in slope range 18 to 50% and above. Atop Bulusan Volcano are barren rocky lands near the crater located at elevation from 1,250 to 1,500 meters with an estimated area of 80 hectares.

Existing Land Uses

The existing land uses in the municipality are categorized into: **Urban Use Areas** (residential, commercial, infrastructure/utilities, institutional, parks/playgrounds and industrial), **Agriculture, Forest and Forest Use, Agro-Industrial, Tourism, Other Uses** (cemeteries, dumpsite/sanitary landfill, vacant lands) and **Water Uses**.

Agricultural lands dominate the landscape of the municipality with a total aggregate area of 12,014.87 hectares or 79.57% of the total land area. The agricultural lands are primarily devoted to permanent crops of palay, coconut and other crops. Vegetables, citrus, fruit trees, bananas and root crops are either found in areas not planted to permanent crops or serves as intercrop on coconut lands. Agricultural lands can be found in all barangays except in the urban barangays of San Julian, San Juan and San Agustin.

The second dominant land use is forestlands with an approximate area of 2,336.71 hectares or 15.48% of the total

land area. Lands with forest cover include protection lands or NIPAS areas which is part of the BVNP with an area of 1,045.7132 hectares located in Cogon. Significant forest cover in non-NIPAS areas can be found in BVNP buffer zones in Cogon, Monbon, Bagsangan, Patag and Mapaso, in Mt. Jormajam in Bolos and Cogon, in Mt. Maraot Banwa in Tabon-tabon and Cawayan. These non-NIPAS forest have an estimated area of 1,291 hectares.

Urban use areas comprise only 3.1% of the total land area or 467.159 hectares. Residential areas covers 318.582 hectares, followed by roads and infrastructures with 90.917 hectares, institutional areas with 47.562 hectares, commercial areas with 6.861 hectares, parks and playgrounds with 3.178 hectares and industrial sites with 0.06 hectares.

The banks or easement of rivers and creeks are categorized under water uses and covers 257.75 hectares or 1.71% of the total land area. There are only 5 hectares each of land used for agro-industrial and tourism purposes. Categorized under other uses are cemeteries with 2.77 hectares, dumpsite/sanitary landfills with 1.87 hectares and vacant lots with 7.84 hectares.

The two major classifications of land in the Philippines are the **alienable and disposable** and the **forest lands**, both of which are considered lands of public domain. Alienable and disposable lands refer to those which have been declared but not needed for forest purposes. Forest lands are areas in the public domain that have been classified for forest use such as public forest, permanent forest or forest reserves, timberlands, grazing lands, game refuge and bird sanctuaries, and areas which are not yet declared alienable and disposable. Of Irosin's gross land area, 13,037.5024 hectares or 86.35% is classified as alienable and disposable lands.

Irosin's lands that are classified as forest lands have a total area of 2,061.4658 hectares or 13.65% of the municipal

land area. The Bulusan Volcano Natural Park (BVNP) which is classified as a protected area has an area of 1,045.7132 hectares. Lands classified as timberlands can be found in Mt. Maraot Banwa, Tabon-tabon with an area of 372.0559 hectares, in Cawayan with almost 400 hectares, in Mt. Jormajan, Bolos with an area of 167.4083 hectares and in Liang with 76.4970 hectares.