Spatial Analyses of the Mining Situation in Mindoro Island, Philippines: Input to the Institutional Position Paper on Mining of the Mindoro Biodiversity Conservation Foundation Inc.

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List of Acronyms

ADB	Asian Development Bank
AFMA	Agriculture and Fisheries Modernization Act
CADC	Certificate of Ancestral Domain Claim
CADT	Certificate of Ancestral Domain Title
CARL	Comprehensive Agrarian Reform Law
CBD	Convention on Biological Diversity
CBFM	Community-Based Forest Management
CLUP	Comprehensive Land Use Plan
CPPAP	Conservation of Priority Protected Areas Project
CRM	Coastal Resource Management
DENR	Department of Environment and Natural Resources
DRRM	Disaster Risk Reduction and Management
ENSO	El Niño Southern Oscillation
EO	Executive Order
EP	Exploration Permit
FMB	Forest Management Bureau
FTAA	Financial or Technical Assistance Agreement
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
KBA	Key Biodiversity Area
IBA	Important bird Areas
IPRA	Indigenous Peoples Rights Act
ISF	Integrated Social Forestry
IUCN	International Union for the Conservation of Nature
MBCFI	Mindoro Biodiversity Conservation Foundation Incorporated
MDG	Millennium Development Goal
MEA	Millennium Ecosystem Assessment
MGB	Mines and Geoscience Bureau
MPSA	Mineral Production Sharing Agreement
NAMRIA	National Mapping and Resource Information Authority
NBSAP	National Biodiversity Strategy and Action Plan
NCIP	National Commission on Indigenous Peoples
NIPAP	National Integrated Protected Areas Programme
NIPAS	National Integrated Protected Areas System
NSO	National Statistics Office
OFW	Overseas Filipino Worker
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PAWB	Protected Areas and Wildlife Bureau
PBCPP	Philippine Biodiversity Conservation Priority-setting Program
PD	Presidential Decree
PEF	Peace and Equity Foundation
PHIVOLCS	Philippine Institute on Volcanology and Seismology
PHO	Provincial Health Office
PPDO	Provincial Planning and Development Office
PTFWRDM	Presidential Task Force on Water Resources Development and Management
RA	Republic Act
SEPO	Senate Economic Planning Office
UN	United Nations

A. Introduction

Mindoro Island, situated in the central part of the Philippines, constitutes one of the major biogeographic regions in the country, exhibiting high levels of species richness and a diverse range of habitats. It is home to the critically endangered Mindoro Dwarf Buffalo (*Bubalus mindorensis*), locally known as the *"tamaraw,"* which is found only in Mindoro and is considered as the largest endemic mammal in the Philippines. Apart from its wealth of biological resources, Mindoro is also the home of the indigenous Mangyan tribes, making the island one of the important cultural centers of the Philippines.

The National Biodiversity Strategy and Action Plan (NBSAP) and the Endemic Bird Areas study by BirdLife International highlights Mindoro as a global priority conservation area. Mindoro's global conservation significance underscores the need for immediate conservation interventions to preserve the island's remaining habitats and important wildlife.
Like many of the unique islands of the Philippines, Mindoro's natural wealth is threatened by anthropogenic activities such as land conversion, illegal wildlife hunting, and timber poaching. It is also consistently assailed by large-scale mining applications.

The revitalization of the mining industry as a key vehicle for economic growth was a major policy of government during the administration of former President Gloria Macapagal-Arroyo. Significant developments in achieving that goal were made such as the issuance of major policies, resolution of judicial challenges, international government and mining industry road shows, and extensive media activities. All these were geared towards courting investments and developing new mines all over the country. The revitalization program identified 23 priority projects targeting as much as US$ 6.5 billion in foreign direct investments. Mindoro, due to its largely untapped mineral resources, was included in the list of priority mining project areas.

On one side, the national government forcefully promotes and prioritizes the mining program; on the other, local stakeholders, civil society groups, and communities remain averse to resource extractive industries in preference of environmentally sound development. This polarized situation has led to conflicts between two competing resource use priorities.

The Mindoro Biodiversity Conservation Foundation, Inc. (MBCFI) was established to address the long-term conservation of Mindoro's endemic wildlife and their natural habitats for the benefit of future generations of all people. Its mandate is to develop integrated biodiversity conservation and development programs, which include improved dissemination of knowledge, management practices, and the active participation and collaboration of relevant stakeholders.

This study was commissioned by MBCFI to gain a better understanding of competing development priorities in Mindoro, particularly mining and biodiversity conservation. The inputs from this study aims to support the formulation of an institutional position paper in relation to mining, which is envisioned to guide the strategic direction of MBCFI's conservation work and initiatives in Mindoro.

B. Objectives, Scope, and Methodology

The general objective of this study is to assess the revitalized mining program in the Philippines and its implications to the conservation initiatives in Mindoro Island. Specifically, the study should provide inputs to facilitate the formulation of an institutional position paper of MBCFI concerning mining in Mindoro.

To achieve this, the Philippines' unique natural endowments and geographical situation was discussed to gain a broader understanding of the backdrop on which Mindoro's potential resource use conflicts arise (which may, in fact, occur in other localities of the country). In view of this, Mindoro's physical and socio-economic characteristics were examined through spatial analyses. Relevant national policies and legislations, including global and country-level ecosystems analyses were also reviewed. Finally, a summary of inter-related issues and concerns evolving from the analyses was presented, and concluded by a section on recommendations and next steps.

Spatial analyses of geographic elements and overlays of different thematic maps were undertaken using geospatial tools, particularly a geographic information system (GIS). Maps were scanned and digitized for incorporation in a GIS, while tabular information such as technical descriptions and other coordinate data were encoded. Through an open-source GIS platform, spatial data were incorporated in order to facilitate data integration, manipulation, calculation, and analyses.
The spatial thematic data included in the analyses involved, among others:

- Major watersheds of the Philippines and Mindoro delineated from available digital elevation models;
- Forest cover of the Philippines (1987) and Mindoro (2003) from the National Mapping and Resource Information Authority (NAMRIA);
- Biodiversity conservation priority areas from the Philippine Biodiversity Conservation Priority-setting Program (PBCPP), which were adopted in the 2nd NBSAP;
- Mining tenements and applications in the Philippines (as of 2004) and in Mindoro (as of 2008), and potential mineral resource areas from the Mines and Geosciences Bureau (MGB);
- For Mindoro, climate types from the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA); various tenurial instrument data from the Department of Environment and Natural Resources (DENR), and the National Commission on Indigenous Peoples (NCIP); and socio-economic information from the Census of Population and Housing data of the National Statistics Office (NSO), and the Provincial Governments of Mindoro Occidental and Mindoro Oriental, particularly the Provincial Planning and Development Offices (PPDO) and the Provincial Health Offices (PHO);
- Administrative boundaries from DENR (i.e., coastline, municipal).

The poverty map of Mindoro Island was constructed to aid in identifying the priority areas for development and conservation work of MBCFI at the municipal level. Analyzed with biophysical and environmental variables, it seeks to provide a better context for understanding the situation of Mindoro's environment and its communities, and determining specific interventions to address resource use conflicts, particularly between conservation and mining. Poverty indicators were developed using socio-economic variables (such as housing, sanitation, education, health, and economic characteristics), which follow NSO's Annual Poverty Indicators Survey, and mapped using the poverty mapping framework by the Peace and Equity Foundation (PEF). An overall development index provides a sequential ranking of the municipalities of Mindoro (island-level) based on a number of significant indicators (which follow PEF's model and are mostly aligned to selected poverty indicators used by NSO). It is computed by getting the average (equal weight) of the index values of all indicators (note: an index of 1 indicates the municipality is relatively better off, and 0, worst off). The performance of each indicator is expressed as a value between 0 and 1 by applying the following general formulas:

$$\text{Per Indicator Index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}} \qquad \text{Overall Development Index} = \frac{\sum \text{of 10 indices}}{\text{10 indices}}$$

The section presenting the key findings from significant ecosystems assessments conducted by various research organizations intends to provide information and insights from cases demonstrating the dichotomy between environmental sustainability and resource extractive endeavors such as mining. The reports that were reviewed include the United Nations' Millennium Ecosystem Assessment and the Mining and Critical Ecosystems Initiative by the World Resources Institute.

C. Situation Analysis

Considering its relatively small size, the Philippines is a country that possesses remarkably diverse and rich resources. Formed by the confluence of volcanic islands arising from the depths of the Pacific Ocean’s Ring of Fire, the Philippine archipelago is one of the most geologically active places in the planet (Heaney and Regalado 1998). This phenomenon, which began as early as 50 million years ago, resulted in an archipelago of

7,000 and more islands that abound with rich biodiversity in its forests and seas, and harbor valuable minerals in its hidden depths.

In terms of biodiversity, the Philippines is one of the 17 mega-diverse countries in the world with more than 52,177 known species, half of which are endemic to the country (Ong *et al*. 2002). The iconic species such as the critically endangered Philippine Eagle (*Pithecophaga jefferyi*) is even known to inhabit only certain islands in the Philippines, and nowhere else in the world. Mineral-wise, the country's mineral endowments are among the highest in the world, especially for copper, gold, nickel and chromite (MGB 2009). These mineral resources are said to have the potential to place the Philippines among the top 10 mining powers in the world (Defensor 2005).

In the face of this abundance, however, are raging issues and conflicts as the country of more than 88 million people struggles to survive and confront various development challenges. The biodiversity that is considered among the richest in the world is also the most threatened, continuously being depleted by a variety of human-induced threats. In seeking for ways to answer the country's economic needs, the government has set its sights towards harnessing its mineral resources.

Former President Gloria Macapagal-Arroyo declared the policy of revitalizing the mining industry in January 2004 as a key vehicle for economic growth. The revitalization program identified 23 priority projects targeting as much as US$6.5 billion in foreign direct investments. Outside of these 23 projects, the entire mining industry was vigorously overhauled, as permitting processes were streamlined and dormant projects canceled in further attempts to attract new players.

The revitalization program has given rise to conflicts in social, environmental and developmental sectors. Historically, the country's mining industry has been a largely contentious issue, fraught with campaigns and struggles, hostility between the mining industry and government on one hand, and communities and civil society on the other, militarization, corruption, employment problems, health hazards, displacement of indigenous communities, and adverse impacts to the environment such as soil subsidence, mine tailings spills, and siltation (e.g., Tujan and Guzman 2002, Tujan 2002, Macdonald and Ross 2003, Christian Aid and PIPLinks 2004, Doyle *et al*. 2007, Leung 2008).

Viewed from a resource use perspective, an initial picture of the country's landscape easily reveals inherent conflicts. In the PBCPP, Ong *et al*. (2002) identified 170 terrestrial and 36 marine biologically important conservation areas, which were adopted in the NBSAP. These areas represent the entire range of the country's rich biodiversity—a showcase of superlatives that forms part of humankind's global heritage. The MGB, on the other hand, delineated the mineral resource potentials throughout the country, and further mapped the overlaps between these high mineral potential areas against high biodiversity conservation priorities. The resulting boundary overlaps between these conflicting resource areas determined by MGB yielded an estimated area of 4.9 million hectares or about 45% of the total land area of terrestrial conservation priority areas that are also high potential mineral areas (Figure 1).

These conflicting resource areas give rise to considerable concern, as the country's threatened biodiversity face further pressure from increased mining activities. Mining is a legitimate and potentially profitable industry that can provide much needed revenue and employment and ease the economic burden of the country. However, Power (2002) argues that solid mineral-dependent countries showed slower growth in per capita income compared to other developing countries, even exhibiting negative growth rates, and concludes that mining in itself cannot trigger and sustain economic development. On the other hand, biodiversity sustains the country's ecosystems, provides valuable resources, and forms the backbone for genuine sustainable development—both a national treasure and a global heritage that can continue to bestow benefits for generations to come.

1. National Context

a. Biological Resources

Biodiversity

The Philippines is one of the richest countries in the world in terms of biological diversity. It even boasts, as a point of comparison, more endemic species on a per area basis than much larger countries like Brazil and Madagascar, such that the Philippines is commonly thought of as the "Galapagos Island multiplied tenfold" (Heaney and Regalado 1998).
However, the Philippine archipelago is also recognized as one of 34 global biodiversity hotspots that is under a high degree of threat (Myers *et al*. 2000). Less than 6% of its original forest remains, and 680 species are listed as globally threatened under the International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species of 2010 (IUCN 2010a; Conservation International-Philippines *et al*. 2006). The main threats to Philippine biodiversity include the destruction of natural habitats, unsustainable resource use practices and development activities due to increasing human population pressure. This situation has led to the Philippines being regarded as one of the highest global priorities for the conservation of biodiversity (Mallari *et al*. 2001).

The National Integrated Protected Areas System (NIPAS) Act of 1992 (RA 7586) is the primary policy for biodiversity resource management in the country. It provides the enabling mechanism for the identification of protected areas, which are set aside for their unique physical and biological significance, managed to enhance biodiversity, and protected against destructive human exploitation. In 2002, the DENR recognized 244 protected areas as NIPAS components composed of both terrestrial and marine havens aimed at preserving the country's rich natural and cultural heritage (Ong *et al*. 2002).
Through a US$20 million grant from the World Bank, the DENR pilot-tested the NIPAS through the Conservation of Priority Protected Areas Project (CPPAP) in 1994, and was followed by the National Integrated Protected Areas Programme (NIPAP) that was funded by an €11 million grant from the European Union. However, despite formidable financial support, CPPAP only managed to secure legislation for half of its 10 project sites; NIPAP fell short of its targets as well (Arquiza 2004). According to its final report in 2004, the World Bank assessment found the implementation of CPPAP "unsatisfactory" (World Bank 2004).

In 2001, Haribon Foundation and BirdLife International identified and compiled a directory of Important Bird Areas (IBA) in the Philippines, which are good tools for identifying spatial priorities for conservation because they are significant for the conservation of other flora and fauna in addition to birds (e.g., Stattersfield *et al*. 1998, Mallari *et al*. 2001, BirdLife International 2004, De Alban 2005). Birds are also the best known and most documented terrestrial taxonomic group in the Philippines, and are a good indicator for other terrestrial taxa at coarse scales (e.g., Tabaranza and Mallari 1997, Stattersfield *et al*. 1998, Balmford 2002).

The IBA directory, along with other studies, has influenced the revision of the first NBSAP for the Philippines in 1997, which was developed and adopted by the national government to address the country's grave biodiversity crisis (Ong *et al*. 2002). This revision is embodied in the PBCPP, or in other words the second iteration of the NBSAP, which incorporated the IBAs as part of the 206 identified biodiversity conservation priority areas in the country. The PBCPP outlined the biological justification and recommendations for prioritizing geographic areas for conservation in the country.

In 2002, 206 conservation priority areas, comprised of both terrestrial and marine areas, have been identified under the NBSAP. From this list of conservation priority areas, 128 were subsequently delineated in 2006 as terrestrial Key Biodiversity Areas (KBA) in the Philippines based on the standard criteria of vulnerability and irreplaceability. This was updated by Conservation International-Philippines *et al*. (2009) through the incorporation of marine KBAs throughout the archipelago; thereby constituting the 228 priority sites for conservation in the Philippines.

These KBAs represent the diverse range of habitats found within the archipelago, including forests, coastal/marine, and wetland ecosystems in general. The KBAs, which similarly builds on the IBA concept, are sites of global biodiversity conservation significance that intend to support viable populations of trigger species across several taxonomic groups (Eken *et al*. 2004). These are an appropriate framework for identifying fine-scale conservation priorities in the country (Conservation International-Philippines *et al*. 2006). As

Langhammer *et al*. (2007) had concluded, site-scale conservation is by far considered the best option for biodiversity conservation. Most of these KBAs, however, lack formal governmental protection. In fact, only 45 of the 128 KBAs identified in 2006 benefit from official protection status, after having been established under the NIPAS of the country (Conservation International-Philippines *et al*. 2006).

Forest Ecosystems and Watersheds

Forest ecosystems provide major ecological services that directly supports approximately 30% of the Filipino population, including some 12 to 15 million indigenous peoples who depend on forests for their survival and whose cultures revolve around their interactions with their natural environment (PAWB 2009). Philippine forests consist of patches of primary (old growth) and secondary growth forests; the largest remaining forest patches in the Philippines are found in the Sierra Madre mountain range in Luzon, Palawan, Mindanao, and Eastern Visayas (PAWB 2009). According to the Forest Management Bureau (FMB), forest cover in the Philippines declined from 17.1 million hectares in 1934 to about 5.39 million hectares in 1996. By 2002, the remaining old growth forest was estimated at 804,900 hectares, or 14.9% of total forest cover.

According to DENR and UNDP (2006), deforestation in the Philippines from 1990-1995 proceeded at an estimated rate of 130,000 hectares per year, while the average rate of reforestation for the same period was 76,548 hectares, resulting in a net forest denudation rate of 53,452 hectares. There is a huge discrepancy, however, between the quality of forest being lost compared to the forest being restored. For 1996-2000, the annual average reforestation rate declined to about 45,000 hectares. No published data has been made available on the annual deforestation rate during this decade. The causes of deforestation in the last 10 years have also not been empirically established by FMB.

The decline of Philippine forest cover has been a major concern. Kummer (1992) observed that deforestation in the country was primarily brought about by commercial logging of old growth forest, followed by the clearing of residual forest for agricultural use of upland settlers. Upland agriculture was facilitated by logging through the building of roads, which opened up the forests.
Most, if not all, of the forest cover statistics available for the Philippines showed the extent of remaining forests per administrative management units (e.g., provincial, regional), which fails to evaluate forest conditions based on its biological and ecological importance. Hydrological boundaries are not congruent with political boundaries (FAO and CIFOR 2005). Analyzing forest cover data using natural management units such as watersheds is a more useful approach in identifying future directions in forest management.

The Revised Forestry Code of 1975 (PD 705), while already outdated, remains to be the primary forest policy governing the use and management of forest resources and watersheds. A new bill on Sustainable Forest Management hopes to address the needed reforms in the forestry sector, but its enactment is delayed in Congress since 2000.

Watersheds are interchangeably referred to as a river basin, or a drainage basin, or a catchment. In the Philippines, watersheds vary greatly in size and extent, and usually transcend the boundaries of administrative units. A watershed typology was developed by PCARRD-DOST *et al*. (1999) as a mechanism for managing watersheds in the country (Annex 1).

Watersheds perform multiple functions, which may be classified into economic and ecological functions (Bautista and Tan 2003). The performance of these functions hinges on the integrity of the watershed, which is largely dependent on its forest cover. A watershed with adequate forest cover supports lowland agriculture by providing continuous supply of water for irrigation, and also sustains the supply of surface and groundwater for domestic use in the lowlands (DENR and UNDP 2006).

Table 1. Forest cover of the 18 major watersheds in the Philippines (Source: De Alban *et al*. 2005).

Major watersheds	**Area of river basin (km^2)**	**Forest area in river basin (km^2)**	**% Forest cover of river basin**
Abra River Basin	4,921.020	959.683	19.502
Abulog River Basin	2,977.044	1,550.500	52.082
Agno River Basin	6,342.325	853.710	13.461

Agus River Basin	1,897.534	1,000.720	52.738
Agusan River Basin	12,768.411	7,082.556	55.469
Bicol River Basin	3,057.477	91.943	3.007
Buayan-Malungan River Basin	1,485.410	163.778	11.026
Cagayan de Oro River Basin	1,689.529	319.307	18.899
Cagayan Valley River Basin	27,663.924	9,262.703	33.483
Davao River Basin	1,366.311	441.022	32.278
Ilog-Hilabangan River Basin	1,827.025	30.850	1.689
Jalaud River Basin	1,754.340	98.664	5.624
Pampanga River Basin	12,317.292	1,833.321	14.884
Panay River Basin	2,148.619	13.141	0.612
Pasig-Laguna River Basin	4,312.990	192.587	4.465
Rio-Pulangi River Basin	20,080.523	3,157.921	15.726
Tagoloan River Basin	1,574.313	297.131	18.874
Tagum-Libuganon River Basin	2,508.847	494.454	19.708

The Presidential Task Force on Water Resources Development and Management (PTFWRDM) identified 18 major river basins or watersheds in the country. Javier (2003) illustrated that good forest cover for a watershed is estimated at 60-75% in order to minimize surface runoff and soil loss. Watersheds with 37% forest cover or less experience surface run-off to as much as 14-75% of rainfall that it receives. Out of these 18 watersheds, 13 have forest cover below 20%, and most of these are relatively small watersheds (Figure 2, Table 1). This indicates that these watersheds and their dependent local communities are very much prone to floods and soil erosion. Watershed degradation also results in diminished capacity to regulate water supply.

The country's upland population is highly dependent on forest-based resources. Due to the following factors: (1) Limited access to alternative livelihood sources, (2) lack of technical skills in managing forest resources available, (3) lack of government's serious implementation of formulated policies and ordinances on forest protection, (4) uncoordinated efforts of various stakeholders, and (5) the lack of appropriate financial schemes to support biodiversity conservation initiatives—these contribute to upland populations' becoming one of the most vulnerable sectors and the forefront pressure on forest resources and biodiversity.

The continuous and rapid decline of forests poses a myriad of threats to both people and biodiversity. It exacerbates biodiversity loss and accelerates species extinction (especially forest-dependent or forest-specialist species). Forest loss also contributes to further carbon emissions (i.e., total contribution of forest habitat loss to global carbon emissions is 20% according to the 2007 IPCC report on climate change), degradation of ecosystem services and benefits threatening watersheds that protect the sustainable supply of potable water, increases the risks of communities climate-related disasters, and depriving the rural communities of the economic gains from forest-based enterprises.

Coastal and Marine Ecosystems

The marine biodiversity of the Philippines is one of the richest and most exceptional on the face of the earth. Its coral organisms is by far the richest in the world with about 430 coral species and 1,030 coral reef fish species, approximately 1,062 species of seaweeds, 22 species of marine mammals, 5 marine turtles, and 16 out of 20 seagrass species in the East Asian region (Ong *et al*. 2002, UP-MSI *et al*. 2002).

A study by Carpenter and Springer (2005) revealed the Philippine islands as the global center of marine biodiversity, where the highest diversity and endemism of species is located. The focal point of this center was further determined to be the central Philippines, particularly in the Verde Island Passage between Mindoro and Luzon islands. Although neighboring Indonesia has over twice the reef area of the Philippines, there is a higher concentration of species per unit area in the Philippines than anywhere in Indonesia or the world (Carpenter and Springer 2005).

In the Philippines, coral reefs provide economic benefits estimated at US$1.1 billion annually, which primarily comes from sustainable fisheries. It has 25,815 km^2 of coral reef area, the second highest in the Southeast Asian region next to Indonesia (Burke *et al*. 2002). These coral reefs supply 11-29% of the total fisheries production in the country. Aside from fisheries, economic benefits from reefs include coastal protection (erosion prevention), tourism and recreation, and aesthetic value.

The Philippine fisheries sector, although not a dominant contributor, plays an important role in the sustainable growth of the Philippine economy (BFAR 2003). The fisheries sector is fundamentally important because fish and other marine products contribute substantially to the daily per capita consumption of every Filipino, and make up the second most important food of the Filipino diet next only to rice (Babaran *et al*. 1998). The significance of the fisheries sector to the national economy and simply as food on the table is very dependent on its diverse and abundant biological marine resources.

The concentration of restricted-range endemic marine species in the Philippines is also depressingly perceived as a danger of mass extinction of epic proportions due to the critical status and high level of threat to its marine environments. The survey in 1997 showed that only 4% of Philippine coral reefs were found in excellent condition with 75% coral cover (Burke *et al*. 2002). It is estimated that 98% of Philippine reefs are threatened by a variety of damaging human activities—mainly due to overfishing and destructive fishing methods, coastal development, sedimentation, and land use conversion with 70% at high risk to very high risk (e.g. Babaran *et al*. 1998, Burke *et al*. 2002, Green *et al*. 2003). Burke *et al*. (2002) also pointed out that the total losses from unsustainable and destructive fishing practices in coral reefs over a 20-year period are very significant and cannot be neglected.

The major policies guiding the utilization and conservation of coastal and marine resources in the country are the Fisheries Code of 1998 (RA 8550) and the Agriculture and Fisheries Modernization Act (AFMA) of 1997 (RA 8435). But there is no comprehensive legislation, however, that coherently puts together the pieces of provisions found in several laws that have direct bearing on the development, conservation, and protection of coastal and marine resources and habitats (DENR and UNDP 2006).

DENR and UNDP (2006) also state that one of the major concerns in coastal resource management (CRM) is the failure to integrate CRM plans with the comprehensive land use plans (CLUP), which were designed as separate plans, prepared and updated periodically by all cities and municipalities. The CLUP, and its resulting land use zoning ordinance, serves to provide legal basis for land use allocation and development in a locality. Failure to integrate CRMP with CLUP prevents a unified and holistic approach to planning and management of resources, as well as creating redundant planning exercises for local governments resulting in duplication of efforts and wastage of resources. (The independent approach to the formulation of the CRMP and CLUP results to some related upland issues not addressed in the CRMP because of the plan's narrow geographic focus. Some examples of these issues are, coastal water pollution and siltation caused by land-based activities such as pesticides runoff from upland agriculture, heavy metals from mining wastes, soil erosion and siltation from denuded watersheds, and lack of solid waste management in coastal settlements.

Wetland Ecosystems

Wetlands are among the world's most productive environments. They support high levels of biological diversity, serving as important habitats upon which various plants and animals depend for survival. Wetland ecosystems also provide economic benefits, enable the storage and provision of clean water for human use, and provide a range of important goods and services ranging from food and building materials, to water filtration, transport, flood and soil erosion control, recreation and tourism opportunities, and a critical resource for the livelihoods of many communities around the world, among many others (Millennium Ecosystem Assessment 2005, Ramsar Convention Secretariat 2007, Darwall *et al*. 2008).

Philippine wetlands are rich in biodiversity, and include ~114,000 hectares of freshwater lakes; ~527,000 hectares of swamp and estuaries; ~176,000 hectares of brackish ponds; and ~130,000 hectares of man-made reservoirs (DENR 1997, Scott 1989). However, the high value and importance of the country's freshwater ecosystems is often overlooked such that wetlands are threatened by drainage and conversion into other ostensibly profitable uses. Wetlands, in fact, continue to be among the world's most threatened ecosystems. In the Philippines, wetlands are greatly under pressure and are considered to be a major conservation gap.

Major threats to Philippine wetlands include: habitat conversion, water pollution, the introduction of exotic species, overfishing, and siltation caused by deforestation of watershed areas.

Wetlands constitute 19 (or ~15%) of the 128 KBAs initially identified in 2006, but less than half have been established as protected areas under the NIPAS, let alone have formal protection. Only four of these wetland KBAs have also been elevated as internationally important wetlands, or Ramsar sites, under the Ramsar Convention on Wetlands of 1971, particularly: Tubbataha Reef Natural Park, Olango Island Wildlife Sanctuary, Lake Naujan National Park, and Agusan Marsh Wildlife Sanctuary. To date, no new nomination has been made although candidate sites have been identified.

According to the 3rd Philippine National Report to the Convention on Biological Diversity (CBD) in 2005, the Philippines has no existing national policy on wetlands; even the National Wetland Action Plan crafted in 1996 needs to be revisited. Data deficiency is also among the major gaps on Philippine wetlands as information on many threatened component migratory species such as marine turtles, dugongs, and waterbirds, and even the status of critical habitats remains unaddressed. Aside from limited site-specific data, there is no adequate information to fully describe the state and trend of inland waters biodiversity in the country (PAWB 2005).

b. Land Resources

Land has played a significant role in society throughout human history—land being the locus of productive activities. The 1976 United Nations Conference on Human Settlements declaration likewise considers land as the principal instrument in fostering social justice, development, provision of decent dwellings, and health conditions, and therefore should be used in the interest of the society as a whole (SEPO 2005). The importance of land utilization in the economic and social activities of society makes it imperative for countries to adopt a comprehensive land use policy to effectively manage the utilization of this valuable resource.

In the Philippines, the principal legislation governing land administration in the Philippines is the Public Land Act (or CA 141) enacted in 1936, which provides for the classification, delimitation, and survey of lands of the public domain. This is complemented by the Property Registration Decree of 1978 (PD 1529), which covers the procedures for original registration of lands under cadastral proceedings. Since the 1970s, government has been undertaking efforts on sound land use. In addition to the national laws mentioned in the previous section (e.g., Revised Forestry Code, the NIPAS Act, the AFMA), various laws have been passed such as the Comprehensive Agrarian Reform Law (CARL) in 1988 (RA 6657); and the Indigenous Peoples Rights Act (IPRA) in 1997 (RA 8371), to ensure that land is utilized properly.

However, the multi-stakeholder nature of land utilization and the lack of a comprehensive land use policy framework have resulted in the following problems: (a) confusion due to inconsistent laws on land utilization; (b) continued negative environmental effect on land; and (c) unabated conflicts among different sectors due to competing land use (SEPO 2005).

Llanto and Ballesteros (2003) discussed that land in the Philippines is categorized as protected areas, alienable and disposable (A&D), and privately owned lands. Of the total Philippine land area of 29.8 million hectares, 15.88 million hectares are forestlands or protected areas; 14.12 million hectares are A&D lands, of which 64.8% are titled and privately-owned. However, these numbers do not reflect the true situation of Philippine land resources in terms of the various actual uses of land.

As of 2001, about 1.3 million hectares (or ~9%) of the total A&D lands remain untitled. Unclassified forestlands, on the other hand, still remain close to 1.1 million hectares and have had no significant progress in classification. The DENR had already distributed 53% (or 1.146 million hectares) of its target public A&D lands for distribution under the CARL; lease agreements for forestlands, on another hand, were also awarded under the Integrated Social Forestry (ISF) and/or Community-Based Forest Management (CBFM) programs covering a total of 81% (or 1.284 million hectares) of the targeted lands for distribution (DENR and UNDP 2006).

The Senate Economic and Planning Office (SEPO) identified five main uses of land: economic and commercial uses, food production, shelter, environment preservation, and preservation of indigenous peoples. However, these uses cannot be pursued exclusively. This means that compromises and conflicts arise whenever one implements one specific land use over the other. Some examples below on the application of the uses of land in the Philippines illustrates such situations (SEPO 2005):

- Indiscriminate land conversions from agriculture to non-agricultural purposes that persist around the country, which pose the danger of food insufficiency for Filipinos;
- Due to the rapid need of urban centers for housing and the lack of a national land use policy to guide planners, lands allocated for other purposes near these areas (such as agricultural) are utilized for housing;
- Over-exploitation of natural resources to numerous yet conflicting uses that include: forest production, food production, human settlements, watershed, tourism, mineral production, energy production, biodiversity conservation, industrial development, and other economic activities or any combination of the above. Due to these pressures, Philippine forests that are critical to securing the country's water resources in the future continue to dwindle;
- Ancestral domain claims are disputed and in conflict with various interest groups on land utilization, especially regarding ancestral lands rich with mineral resources. The indigenous people communities' interpretations of property rights over identified areas are often not consistent with concession rights given by government through the market economy's land registration and titling system. As a result, indigenous peoples are always faced with a threat of displacement to give way to economic land utilization.
- Among the most pressing concerns facing land management include: (a) conflicting land use and tenure instruments due to lack of decision maps showing overlays of different land claims; (b) inconsistent and outdated land policies such as CA 141, PD 1529, and PD 705; (c) slow rate of land distribution due to the delay in completion of land classification; and (d) the involvement of multiple agencies in land administration thereby resulting in land titling complexities, inefficiencies in operations, and conflicting decisions on titling cases (DENR and UNDP 2006). Land quality is similarly threatened by the loss of topsoil due to erosion and pollution caused by improper disposal of wastes. The extent of prime agricultural lands in the country have also dwindled due to conversion to other land uses such as for housing, and industrial and commercial purposes.

c. Geology and Mineral Resources

Philippine tectonics is one of the most active in the world. The country's tectonic activity is the result of the interaction of three (3) major tectonic plates, namely: the Pacific, the Eurasian, and Indian-Australian Plates. The boundary between the eastern margin of the Eurasian Plate and the Philippine Sea Plate is a complex system of subduction zones, collision zones, and marginal sea basin openings (Aurelio and Peña 2004). An actively deforming zone is created in between these two plates, which is referred to as the Philippine Mobile Belt.

Mineral deposits in the Philippines have formed in three distinct geologic environments: oceanic, island arc, and continental. Many of the tectonic regions in the Philippines are a mixture of several environments due to the amalgamation of different tectonic terrane and the replacement of older geologic environments by younger ones (BMG 1986). Geologic processes lead to the formation of mineral deposits, of which when removed from the earth's surface can never be replaced again and are thus regarded as non-renewable resources.

Due to its complex geologic history, the Philippines' mineral endowments have been recognized as one of the highest in the world, with established reserves of 13 metallic and 29 non-metallic minerals despite its relatively small land area (MGB 2009). According to MGB, the most prominent metallic mineral reserves are gold, copper, nickel, and chromite, of which the country is ranked at 3rd, 4th, 5th, and 6th in world mineral endowments, respectively. Copper makes up the bulk of all metallic reserves in the country; limestone constitutes the largest non-metallic mineral deposits followed by marble.

Mining and quarrying activities occupy about 700,000 hectares of land (DENR and UNDP 2006). There is reportedly no mineral scarcity, considering the country's vast mineral reserves. However, mining is restrained because of the lack of risk capital and state-of-the-art exploration technology. Uncertainties in government policy also hindered foreign direct investments in pursuit of mining in the country. Mining in the Philippines also suffers from poor social acceptability, mainly due to adverse impacts such as improper disposal of mine wastes and tailings, collapse of tailings ponds, and spillage of mine tailings, all of which cause serious environmental damages.

Mineral production is also influenced by the prices of metallic minerals in the world market. For example, China has raised worldwide demand for nearly every mineral commodity that is dug or drilled out of the earth. In 2003 and 2004, the prices of copper and iron skyrocketed in response to Chinese demand, which it requires to sustain its industrialization and stellar economic growth (Fishman 2005).

To revitalize the mining industry, the Mining Act of 1995 (RA 7942) addressed the ambiguities in government policy and provided the instruments to encourage foreign investment. The Small Scale Mining Act of 1991 (RA 7076) also rationalized viable small-scale mining activities to generate more employment opportunities. To address the negative image of the mining industry and its poor environmental record, sound environmental management (such as the environmental impact assessment requirement, a code of conduct, a mine rehabilitation fund, among others) became a policy thrust, which was embodied in the National Mining Policy Agenda and the Mineral Action Plan of 2004.

Executive Order no. 270 (EO 270), signed by former President Gloria Macapagal-Arroyo in 2004, embodies the national policy agenda on revitalizing mining in the Philippines. Together with the Mineral Action Plan, it provided the guiding principles, strategies, and actions to address the obstacles to mining revitalization such as perceived policy instabilities, the tedious permitting process, public concerns over the environmental impacts of mining, inadequate benefits to local communities, and conflicting legislations of local governments.

In 2005, mining applications were found in 15 out of 18 major watersheds (Figure 2). The extent of mining applications over the forests of these watersheds range from at least 7% (Pasig-Laguna watershed) to as much as 100% (Panay watershed); forests in 3 out of the 4 largest watersheds, specifically Agusan, Cagayan Valley, and Rio-Pulangi, were covered by mining applications by no less than 45% of their land area (De Alban *et al*. 2005). The mining revitalization program could continue to aggravate the plight of the country's major watersheds considering that their forest cover are already below the optimum requirement.

By the end of 2009, 312 mineral production sharing agreements (MPSA) had been awarded in the country totaling 499,953 hectares; four financial or technical assistance agreements (FTAA) with a total area of 94,715 hectares; and 51 exploration permits (EP) with a total area of 187,518 hectares (MGB 2010).

Other significant issues confronting mining in the Philippines include (DENR and UNDP 2006):

- Social unacceptability of mining to the public and the affected communities;
- Civil society's distrust in mining firms and doubts about the environmental viability of mining;
- Conflicts between mining law and the provisions of environmental laws such as NIPAS, IPRA, and Environmental Impact Assessment (EIA) system, and the Local Government Code;
- Policy ambiguities on mining such as the unresolved constitutional challenge to FTAAs, a mechanism which allows foreign corporations to stake a claim on mineral resources and undertake development; and in the unresolved issues of the IPRA (e.g., vested rights, priority rights, dispute resolution procedures);
- Perception of mining as an exclusive permanent land use type and lack of updated land use maps;
- Lack of coordination between MGB and local governments in land use planning;
- Unregulated small-scale mining operations;
- Non-rehabilitation of abandoned or inactive mines; and
- Delays in the processing and approval of permits for mineral exploration.

d. Disaster Risks and Climate Change

Natural Hazard Exposure and Vulnerabilities

The Philippine archipelago is situated in the Pacific Ring of Fire where major tectonic plates of the world meet (such as the Pacific, Eurasian, Philippine, and Indian-Australian Plates). This explains the presence of active faults and trenches across the country, and with it the occurrence of earthquakes and tsunamis, and the existence of 220 volcanoes, of which 22 are classified as active because their eruptions were found in historical records.

An average of 20 typhoons visit the country annually, five to seven of which can be rather destructive. The country is located along the typhoon belt on the North Pacific Basin in the Pacific where 75% of typhoons originate. The eastern seaboard is highly exposed to typhoons with wind speeds of 200 km/h, and 25% of typhoons of such high wind speeds in the world occur in the Philippine Area of Responsibility. Mean annual rainfall in the country varies from 965 to 4,064 millimeters. Extreme rainfall events trigger landslides and *lahar* flows are responsible for severe and recurrent flood in low-lying areas. Typhoons are responsible for 47% of the average annual rainfall in the country. Slow moving or almost stationary tropical cyclones account for extended periods of rainfall.

Flooding has become the most prevalent disaster since 2000 (World Bank 2005). Environmental factors such as denuded forests aggravate flood risks. The pace of deforestation since the 1930s accelerated in the 1950s and 1960s, before falling slightly in the 1980s. Even now, the effects of loose soil and reduced forest cover from past forestry activities are felt in frequent landslides and floods. The likelihood of drought and poor availability of water is also increased by the loss of forest cover.

Typhoons or tropical cyclones have caused the most loss of lives and property in the country. Accompanying or resulting from these hazard events are secondary phenomena such as strong winds, landslides, floods/flash floods, tornados and storm surges. There is evidence that the occurrence of extreme weather events is a consequence of climate change. The Philippines may therefore be substantially affected by climate change. The western and central portions of the archipelago are less exposed to the full extent of tropical cyclones that enter the country's boundaries. Provinces with the highest climate risk in Central Luzon are also those with the most urban centers. Climate risk includes exposure to super typhoons, and other extreme weather, El Nino-related droughts, projected rainfall change, and projected temperature increases.

The Philippines has been preparing for regional and emerging risks such as climate change. According to Villarin *et al*. (2008), climate change will influence Philippine weather in terms of changes in temperature, rainfall, and tropical cyclone activity, which in turn will cause impacts in various sectors including agriculture, forestry, and water resources. There is no specific mention of how the Philippines will be impacted by climate change based on the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Villarin *et al*. (2008) identified the following impacts of climate change on the country, which include: rise in sea levels, changes in surface temperature, pattern shifts in tropical cyclones, changes in mean annual rainfall, and climate-induced hazards. These changes can affect various sectors in the Philippines including agricultural production, forest and marine resources, hydropower generation, health, and water availability.

Some parts of the country are more prone to specific hazards than others; some parts are exposed to more hazards than others. In an analysis of natural disaster hotspots by the Hazard Management Unit of World Bank, the Philippines is among the countries where large percentages of the population reside in disaster-prone areas (World Bank 2005). Many highly populated areas are exposed to multiple hazards; 22.3% of the land area is exposed to three or more hazards, and in that area 36.4% of the population are exposed. Areas where two or more hazards are prevalent comprise 62.2% of the total area where 73.8% of the population are exposed.

Natural hazards are part and parcel of the Philippine environment, but disasters happen because human settlements, infrastructure, people and their economic activities are placed where hazards happen. Costs of disaster impacts are borne by government and individual households, thus threatening socio-economic development gains. Other threats that warrant attention are complex emergencies that are primarily man-made, often associated with armed conflict; issues related to internally displaced persons are part of dealing with such threats.

In understanding vulnerability to climate change impacts on the Philippines, the stark reality is that the poor are the most vulnerable and will bear the brunt of climate change impacts. Changes in economic systems will affect them, making access to resources more difficult and further complicating the daily struggle for survival. The relationship of poverty to natural disasters is both cyclical and cumulative (World Bank and NDCC 2005). The sub-national picture is highlighted by disparities in poverty incidence. Majority of the poorest provinces in terms of income are found in the ARMM and Bicol Region while those with the lowest incidences are in Luzon, particularly Regions I to IV.

The Philippines has been identified as one of the most disaster prone countries in the world. Natural disasters, such as floods, typhoons and landslides, account for about 25% of natural disasters reported annually worldwide. According to the National Disaster Coordinating Council (NDCC), between 1990 and 2006, the country incurred an average annual direct damage to agriculture, infrastructure, and the private sector of around Php 19.7 billion (in real 2005 prices), which is equivalent to about 0.5% of GDP per year. Damage to agriculture alone averaged Php 12.4 billion per annum. An average of 1,009 lives is lost every year, with typhoons accounting for 74% of the fatalities, 62% of the total damages, and 70% of the agricultural damages, reflecting their high annual frequency.

Disasters and Poverty in the Philippines

According to World Bank and NDCC (2005), “poverty and vulnerability to natural hazards are closely linked and mutually reinforcing. Poor and socially disadvantaged groups are usually the most vulnerable to hazards, reflecting their social, cultural, economic and political environment. Disasters, in turn, are a source of transient hardship and distress and a factor contributing to persistent poverty. Indeed, at the household level, poverty is the single most important factor determining vulnerability...”

In 2006, almost 27.6 million people lived below the Philippines' poverty threshold. This represents 26.9% of Philippine families and 32.9% of the population (e.g., 33 out of 100 Filipinos were poor) (NSCB 2006). According to international data, 44% of the population subsisted on US$2 or less a day. Poverty is largely a rural phenomenon in the Philippines. The rural poor accounted for about 77% of the poor in 1997 and the agriculture, fishing and forestry sectors alone for two-thirds of the poor.

In the case of the Philippines, linkages between poverty and vulnerability to natural hazards are clearly apparent, despite the fact that they have not been systematically analyzed. The rural population comprises the large part of the nation's poor. Once affected by disasters, the poor may cope by acquiring debt, getting access to lending facilities, and diversification of livelihood strategies. Negative consequences include withdrawal of children from school and a reduction in the quantity and quality of food intake. The participation of the poor in the market economy may also become more limited as roads, particularly feeder roads, become impassable or are destroyed. The increase in poverty in 1998, particularly to the agricultural sector, is attributed to the El Niño drought rather than the financial crisis (World Bank and NDCC 2005).

Very little studies have been done to understand the linkages among poverty, vulnerability and the environment, or the socio-economic impacts of disasters. In the face of all these, mainstreaming of disaster risk reduction into all aspects of national development planning is also generally needed. The 2005 World Bank and NDCC study of the Philippines also observes that: “Despite both the high incidence of disasters in the Philippines and the government's central objective to reduce poverty, efforts to reduce vulnerability to natural hazards are not systematically included as a central component of the government's poverty reduction strategy.” The government's approach has been to deal with post-disaster relief activities to victims.

The 2001 Philippines Poverty Assessment of the World Bank identifies climate and economic instability as the likely main sources of vulnerability and notes the role that effective public policies and regulation in areas such as watershed management, water impounding, drainage, flood control, forestry regulation, housing and zoning standards and trash collection can play in reducing impacts. It also comments that public safety nets are also needed. There was no discussion, however, of the impact that typhoons or other natural hazards can have.

Again, according to World Bank and NDCC (2005), environmental degradation is also playing a significant role in increasing the incidence of natural disasters. Degradation of the environment increases the risk of environmental disasters—another type of event with the potential for devastating results. A number of these disasters have been experienced mainly in densely populated and developed areas of the country.

Demographic growth and poor land-use planning have led to the massive depletion of natural resources and destruction of the environment. Declining forest cover, in particular, is contributing to increased run-off, resulting in more frequent flash flooding, landslides and droughts. To help overcome these trends, it is important to address environmental degradation directly as well as consider land use plans and building codes in addressing physical vulnerability to natural hazards.

In 2010, the Disaster Risk Reduction and Management (DRRM) Act was ratified into law by the two houses of Congress. Together with the Climate Change Act of 2009 (RA 9729), which was signed into law in 2009, the two landmark legislations intend to integrate disaster risk reduction measures and climate change adaptation plans into development and poverty reduction programs. These should provide mechanisms that are essential to reduce the vulnerability of the poor who are also most exposed to disasters. The DRRM and CC Acts also encourage the government to shift its focus to disaster prevention and risk reduction by putting more emphasis on strengthening the communities' and people's capacity to anticipate, cope with, and recover from disasters, as an integral part of development programs. The law provides impetus to community-based disaster risk management.

2. Mindoro Island

Mindoro Island is situated at the central portion of the Philippine archipelago, off the southern coast of mainland Luzon. The island is bounded on the north by the Verde Island Passage, and partly by the South China Sea; on the east by Tablas Strait; on the west by Mindoro Strait; and on the south by the Sulu Sea. Its neighboring islands and provinces include: Batangas province on mainland Luzon to the north; the Calamianes Island Group of the province of Palawan to the southwest; the island province of Marinduque to the northeast; and the island group province of Romblon, and the provinces of Antique and Aklan on Panay Island to the southeast. Mindoro Island is composed of 247 islands and islets, including seven major islands, namely (in order of land area, beginning from the largest): Mindoro, Lubang, Ilin, Ambil, Golo, Ambulong, and Cabra Islands. These islands have a total land area of 1,003,854 hectares (based on the digitized municipal boundary data from NAMRIA 1:50,000 topographic maps). It is divided into two administrative provinces: Mindoro Occidental and Mindoro Oriental, each having 11 and 15 municipalities, respectively (Table 2).

Table 2. Land area of the municipalities and provinces of Mindoro Island.

Province	Municipality	Number of barangays	Land area (ha.)	% to total land area of Mindoro
Mindoro Occidental Total land area: 582,748 hectares (58.05% of total land area of Mindoro)	1. Abra de Ilog	9	58,796	5.86
	2. Calintaan	7	31,399	3.13
	3. Looc	9	12,821	1.28
	4. Lubang	16	12,491	1.24
	5. Magsaysay	12	35,222	3.51
	6. Mamburao	15	30,962	3.08
	7. Paluan	12	52,870	5.27
	8. Rizal	11	18,870	1.88
	9. Sablayan	22	230,336	22.95
	10. San Jose	38	39,310	3.92
	11. Santa Cruz	11	59,670	5.94
Mindoro Oriental Total land area: 421,106 hectares (41.95% of total land area of Mindoro)	12. Baco	27	29,069	2.90
	13. Bansud	13	24,657	2.46
	14. Bongabong	36	48,054	4.79
	15. Bulalacao	15	32,470	3.23
	16. Calapan City	62	24,651	2.46
	17. Gloria	27	27,492	2.74
	18. Mansalay	17	50,547	5.04

	19. Naujan	70	39,759	3.96
	20. Pinamalayan	37	24,347	2.43
	21. Pola	23	10,884	1.08
	22. Puerto Galera	13	22,577	2.25
	23. Roxas	20	8,867	0.88
	24. San Teodoro	8	34,244	3.41
	25. Socorro	26	18,525	1.85
	26. Victoria	32	24,965	2.49
TOTAL		588	1,003,854	100.00

Mindoro Occidental has a total land area of 582,748 hectares (which is 58.05% of the total land area of Mindoro), and occupies the eastern half of Mindoro. Mamburao is the designated provincial capital. Sablayan is the largest municipality in terms of land area, not only for the province but also for the entire island, comprising almost 23% of the total land area of Mindoro. Mindoro Oriental, on the other hand, has a total land area of 421,106 hectares (or 41.95% of the total land area of Mindoro), and occupies the western half of Mindoro Island. Calapan City is the provincial capital. The municipality of Mansalay is the largest town of the province.

Based on NSO DATOS 2002 data, there are 588 barangays found in both provinces of Mindoro with 162 and 426 barangays in Mindoro Occidental and Mindoro Oriental, respectively. Naujan comprises the most number of barangays followed by Calapan City, both situated in Mindoro Oriental province. San Jose consists of 38 barangays, the highest number of barangays in Mindoro Occidental.

a. Biophysical Characteristics

Mindoro Island is basically considered as highland owing to its high relief and dominantly steeply sloping to mountainous terrain. Mt Halcon is the highest summit on the island, standing at an estimated elevation of 2,590 meters above mean sea level (Merritt 1908). High elevations and steeply sloping areas are concentrated at the central axis of the island, running from northwest to southeast. Mountainous terrain comprises 13.94% of the island (Table 3).

Lowland flat areas are mostly situated at the eastern portion of the island, mainly at Mindoro Oriental; the most extensive flat areas are situated in the municipalities of Naujan, Victoria, Baco, and the City of Calapan, which are utilized for agricultural purposes. Although not as extensive as its neighboring province, lowland flat areas in Mindoro Occidental are situated in the municipalities of Sablayan, Santa Cruz, Rizal, San Jose, and Magsaysay.

Table 3. Slope categories of Mindoro Island.

Slope category	**Description**	**Area (ha.)**	**% to total land area of Mindoro**
0 – 3%	Level to gently sloping	278,375	27.70
3 – 8%	Gently sloping to undulating	61,965	6.17
8 – 18%	Moderately sloping	132,690	13.20
18 – 30%	Steeply sloping	164,162	16.34
30 – 50%	Very steeply sloping	227,687	22.66
Over 50%	Mountainous	140,059	13.94
TOTAL		1,004,938	100.00

Note: The area total from the slope computations differs by approximately 11 square kilometers from the computed administrative land area of the islands. This discrepancy is due to the inherent difference in data formats (i.e., raster vs. vector data formats for slope and administrative boundary, respectively), which is best manifested along the coastlines.

Mindoro Island experiences to two climatic types: Types I and III based on the Coronas climate classification (PAGASA *et al*. 1992). The two types are described as follows:

- Type I: There are two pronounced seasons, dry from December to May and wet from June to December. Maximum rain period is from June to September. Areas characterized by this climate type are generally exposed to the southwest monsoon (*habagat*) and get a fair share of rainfall brought by tropical cyclones that occur during the maximum rain period.
- Type III: No very pronounced maximum rain period, with a short dry season lasting only from one to three months. This type is intermediate between Types I and II, although it resembles the first type more closely because it has a short dry season. Areas of this climate type are partly shielded from the northeast monsoon (*amihan*) but are exposed to the southwest monsoon and by the rainfall caused by tropical cyclones.

The boundary between the two climate types is roughly situated over the highlands, stretching from Abra de Ilog going southwest along high elevations to Bulalacao (Figure 3). Areas classified under Type I comprise almost the entire province of Mindoro Occidental, including Lubang and Ilin Islands, and Bulalacao in Mindoro Oriental, but excluding western portions of Abra de Ilog. Mindoro Oriental is mostly classified under Type III, with the exception of Bulalacao, portions of Mansalay, and Bongabong. The noticeable difference in vegetation types on both sides of Mindoro's highlands, for example: grasslands at Sablayan side and forests at Mindoro Oriental side, is a result of rain shadow effect due to the two climate types experienced by Mindoro, the frequency of tropical cyclones, and its topography.

The *amihan* brings moist winds to Mindoro during the dry season. Due to the presence of high mountainous terrain across the central spine of Mindoro Island, the moisture brought by *amihan* descends on the northern and eastern portions of Mindoro, providing these areas with considerable rainfall during the dry season while hardly any rain is felt on the western side. This creates an orographic lifting or rain shadow effect on the leeward western side of the central Mindoro highlands. During the *habagat*, the winds strike directly on the western coast of Mindoro and much of the rainfall brought by these winds precipitate before passing the central highland mountains. The western portion of Mindoro is, therefore, marked by a distinct dry and wet season while the eastern portion has an evenly distributed rainfall through the year (Merritt 1908). Precipitation is spatially varied in Mindoro. Based on historical annual normal rainfall maps from 1961-1990 by PAGASA, the northeast portion of the island (approximately from Abra de Ilog down to Bansud) experiences lower amount of rainfall (at 1–2 meters) compared to all other areas (at 2–3 meters).

From Villarin *et al*. (2008), Mindoro can potentially be affected by the variability of climate patterns particularly in terms of the frequency and intensity of tropical cyclones since typhoon crossings are projected to be more pronounced in the Visayas (or Central Philippines). While it is generally known and accepted that different islands and localities across the archipelago will experience different impacts from climate variability, much is still unknown however on how exactly these hydro-meteorological impacts affect particular islands (such as Mindoro) due to the dearth of site-specific studies.

According to the Philippine Institute on Volcanology and Seismology (PHIVOLCS) maps, Mindoro Island is also susceptible to several natural hazards: fault lines, tsunamis, earthquake-induced landslides, and ground liquefaction. While these hazards are hardly caused by the variability of climate-related events, these can be exacerbated by hydro-meteorological hazards (and the cumulative effect of these various types of hazards), which can potentially result in even more devastating disasters.

From 2003 land cover data produced jointly by FMB and NAMRIA, the dominant land cover features include shrublands, forests (which are divided into 4 subtypes), grasslands, and cultivated lands (Figure 4). Forests are estimated at 192,239 hectares (19.15%) of the total area of Mindoro. These are mainly found on highlands located at the northern half of the island. Sablayan, being the largest municipality, holds approximately 74,666 hectares (38.84%) of the total forest cover of Mindoro. Forest patches of varying types are scattered in the municipalities of Sablayan, San Jose, and Paluan; between the boundary of Pola and Naujan; and Lubang Island, among a few others. Pine forest patches occur only in the municipality of Santa Cruz. Mangroves are sparse and are located along coastlines and at Apo Reef Marine Natural Park.

Shrubland is the dominant land cover that occupies an estimated 33% of the total land area of Mindoro, which are mainly situated in the northwest, eastern, and southern portions of the island. Grasslands, including partially wooded grasslands, take up a quarter (25.63%) of Mindoro's total land area. Grasslands occur more extensively at the western side of Mindoro, due to the effect of climate type and topography. Small patches of grasslands also occur on the Mindoro Oriental side, such as in the municipalities of Bulalacao, Bansud, Bongabong, Mansalay, Gloria, and Pinamalayan.

Cultivated areas also account for almost one-fifth (19.40%) of the total area of Mindoro. Cultivated lands producing annual (or temporary) crops are scattered across the lowland areas of both provinces. Annual crops involve rice, corn, tubers and roots, legumes, vegetables and even tobacco; perennial (or permanent) crops involve coconuts, bananas, cashew, and other fruit-bearing trees (NSO 2004). Cultivated areas producing perennial crop types are more extensive and prevalent in Mindoro Oriental. Other agricultural production land types like fishponds are present only in a few municipalities including: San Jose, Magsaysay, Roxas, and Calapan.

The Philippine mining industry produces a variety of mineral products, classified into six general categories of minerals, namely: precious metals, iron and ferro-alloy metals, base metals, fertilizer minerals, industrial minerals, gemstone and decorative minerals. Figure 5 and Table 3 show the minerals included in each of these categories and those found in Mindoro Island (MGB 2009, BMG 1986):

- Gold deposits are widely distributed throughout the Philippine archipelago but most of the large and productive deposits are situated along the Philippine Fault. While Mindoro is way out of the country's premier gold districts (e.g., Baguio, Masbate, Surigao), one well-known gold deposit in Mindoro is situated in San Teodoro area. Silver in the Philippines is always associated with gold and recovered mainly as a by-product of gold and gold-bearing copper mines.
- Iron and ferro-alloys—important for the production of iron and steel—also occur in Mindoro, particularly within the Abra de Ilog district and Sablayan. Iron deposits found in Abra de Ilog are classified as contact metasomatic deposits, which are usually the main source of lump iron ore; these are also considered to be one of the oldest iron deposits in the country. Those concentrated in Sablayan are classified as laterite deposits of the nickeliferous types which are found over ultramafic rocks, and contain significant amounts of nickel, lead, and silicate nickel ore, apart from iron (BMG 1986). Chromite was first discovered in Mindoro, particularly in Ambil Island, during the early part of the American occupation of the country. Potential chromite deposits are concentrated at the northwestern portion of Mindoro Island.
- For base or non-ferrous metals, copper is the primary metal with lead, zinc, and molybdenum occurring as co-products; gold and silver also occur as important co-products of copper mineralization. Prospects of copper deposits are scattered across Mindoro, but the most significant occurs in Lubang Island. The oldest known lead-zinc mineralization, occurring as a co-product of copper, is found in Sta. Cruz and Lubang Island.
- Prospects of phosphate rock and guano are identified in Ilin Island, San Jose, and Bulalacao. These minerals are utilized as natural raw fertilizers and soil conditioners, and serve as ingredients for the manufacture of inorganic and chemical fertilizers. Guano, for instance, is an important source of phosphorous and nitrogen; these deposits are mostly found in limestone caves, which accumulate through the excrement of birds and bats. Phosphate rock, on the other hand, is the main source for phosphate in chemical fertilizers.
- For industrial materials, minerals found in Mindoro include asbestos, barite, bentonite, feldspar, talc, and silica. Asbestos, utilized for fireproofing, insulation, and brake lining, is found in Abra de Ilog. Barite, a filler and adulterant for glass and oil well drilling industries, is found in the towns of Mansalay and Roxas. Feldspar, which occurs in Looc in Lubang Island, Abra de Ilog, and Pinamalayan, is mainly used as a constituent of glass, fired clay products, and enamels. Silica, similarly found in Lubang Island, is mainly used in glass manufacturing. Talc deposits, mainly used in ceramics and electrical insulators, are identified in Abra de Ilog. Gemstones were discovered in the 1960s by Mangyans along Pagbahan River in Sta. Cruz, Mindoro Occidental. Generally associated as "Mindoro Jade" based on their geologic environments and rock associations, these gemstones are greenish gray to light green in color, and are underlain by greenschist, gneiss, metagabbro, and marble.

Table 3. Classification of mineral products found in Mindoro Island (Source: BMG 1986).

Category	Minerals included	Major location
Precious metals	Gold, Silver	San Teodoro
Iron and ferro-alloy metals	Chromite, Iron, Nickel	Ambil Island, Abra de Ilog, Sablayan
Base metals	Copper	Lubang Island
Fertilizer minerals	Phosphate Rock, Guano	Ilin Island, San Jose, Bulalacao
Industrial materials	Limestone, Feldspar, Marble, Silica	Abra de Ilog, Lubang Island
Gemstones, decorative minerals	Gemstones	

Following the PCARRD-DOST *et al.* (1999) watershed definition, the provincial scale was chosen as the minimum resolution for delineating and identifying watersheds in this report; watersheds smaller than this scale have not been delineated. Watersheds at the provincial level, classified as medium-sized watersheds, range from 100 to 500 km^2, of which the topographic boundaries occur within at least one but not more than two provinces.

A total of 20 watersheds (with areas ≥ 10,000 hectares, or 100 km^2, and above) have been identified on Mindoro Island, and are treated as major watersheds for the purposes of this report. One out of the 20 major watersheds qualifies as a river basin, specifically Magasawang Tubig. Three are considered as large watersheds, including Busuanga, Bongabong, and Amnay; the rest as medium-sized watersheds. These major watersheds occupy a total area of 716,413 hectares (or 71.37% of the land area of Mindoro). Nine of these major watersheds are situated in both provinces of Mindoro, particularly: Magasawang Tubig, Busuanga, Bongabong, Amnay, Cagaray, Pagbahan, Pula, Polo-Salagan, and Balete (Figure 6, Table 4). Magasawang Tubig River Basin, the largest of Mindoro's watersheds, is situated across eight municipalities.

The percentage of forest cover within Mindoro's major watersheds ranges from 0.00% to 59.87% with an average of 21.69% (Figure 7, Table 4). Magasawang Tubig River Basin has the highest proportion of forest cover in relation to its land area. Wasig Watershed, on the other hand, is devoid of significant forest areas and is more dominantly covered by brushlands. Only four watersheds, namely: Rayusan, Bongabong, Magasawang Tubig, and Mongpong, have a forest-watershed area ratio above the average.

Table 4. Major watersheds within Mindoro Island showing computed forest cover within each watershed.

Watershed name	Type (PCARRD *et al.* 1999)	Land area (ha.)	% to total land area of Mindoro	Forest area (ha.)	% of forest within watershed
1. Magasawang Tubig	River Basin	140,222	13.97	83,956	59.87
2. Busuanga	Large Watershed	55,591	5.54	1,717	3.09
3. Bongabong	Large Watershed	55,497	5.53	13,110	23.62
4. Amnay	Large Watershed	53,880	5.37	11,668	21.66
5. Rayusan	Medium Watershed	44,122	4.40	12,086	27.39
6. Butas-Lumangbayan	Medium Watershed	44,028	4.39	3,028	6.88
7. Cagaray	Medium Watershed	42,930	4.28	3,662	8.53
8. Pinagsabaran	Medium Watershed	38,879	3.87	1,012	2.60
9. Lumintao	Medium Watershed	36,991	3.68	1,801	4.87
10. Mongpong	Medium Watershed	32,305	3.22	7,721	23.90
11. Pagbahan	Medium Watershed	31,492	3.14	4,253	13.51
12. Pula	Medium Watershed	24,149	2.41	1,230	5.09
13. Polo-Salagan	Medium Watershed	24,009	2.39	816	3.40
14. Wasig	Medium Watershed	16,382	1.63	0	0.00
15. Labangan	Medium Watershed	14,227	1.42	1,315	9.24
16. Abra de Ilog	Medium Watershed	13,438	1.34	2,527	18.80
17. Balete	Medium Watershed	13,153	1.31	1,563	11.89

18. Anahawin	Medium Watershed	12,304	1.23	676	5.49
19. Maragooc	Medium Watershed	11,604	1.16	1,568	13.51
20. Sumagui	Medium Watershed	11,211	1.12	1,697	15.14
TOTAL		716,413	71.37	155,406	

Land tenure instruments affect how site conservation management and planning are implemented in the country. It is necessary to take these prior rights and arrangements into consideration to come up with an appropriate management system, especially if the critical wildlife habitats and conservation sites are already under an existing tenurial instrument. Major tenurial instruments in Mindoro Island include, but are not limited to, the following: protected areas, certificates of ancestral domain titles and claims (CADT/CADC), mining tenements, CBFM areas, and special reservations (Figure 8). Annexes 2 to 5 provide the details on each instrument.

Seven protected areas are found in Mindoro. Annex 2 provides a detailed list of protected areas under the NIPAS. Identified protected areas more or less represent each of the major habitat types or ecosystems in Mindoro, particularly: forests and grasslands (Mts Iglit-Baco, Mt Calavite, Mt Kadangyasan); lake or wetland/freshwater systems (Lake Naujan); mangroves (Apo Reef, Mindoro Mangroves), and coastal/marine (Apo Reef).The status of each protected area is in various stages under the NIPAS Act. F.B. Harrison Game Refuge and Bird Sanctuary, in particular, has been proposed for declassification as a protected area and delisted from the initial NIPAS components (Haribon Foundation 2004).

Ancestral domains in Mindoro belong to the Mangyan tribes, which consists of eight sub-tribes including: Alangan, Batangan, Buhid, Iraya, Hanunuo, Sulodnon, Tadyawan, and Tau-Buid. Annex 3 provides a comprehensive list of approved titles and existing claims of ancestral domains in Mindoro. Two ancestral domain titles have been approved to the Iraya Mangyan tribe situated in Mindoro Oriental in 2004. Eleven claims are presently in the pipeline for application as ancestral domain titles. Ancestral domains have an aggregate land area of 296,664 hectares, covering almost 30% of the total land area of Mindoro.

A total of 92 mining tenements, with a total land area of 607,759 hectares (or 60.54% of the total land area of the entire island), have been applied over Mindoro Island as of January 2008 (Figure 8, Annex 4). These mining tenements are classified into EPs, MPSAs, and FTAAs.

Community-based forest management areas are found in the municipalities of Bulalacao and San Teodoro in Mindoro Oriental. Annex 5 provides a partial list of CBFM areas. The number of CBFM areas in each town consists of, but is not limited to, the following: four in Bulalacao, and two in San Teodoro. One CBFM area has been reported in Sablayan, Mindoro Occidental, particularly in Sitio Palbong, adjacent to the Sablayan Prison and Penal Farm (SPPF) covering Mt Siburan (Haribon Foundation 2004).

Other tenurial instruments include government reservations and special projects. Sablayan Prison and Penal Farm in Sablayan, Mindoro Occidental was established by Proclamation No. 72 on 26 September 1954 as a special reservation among other government penal colonies in the country. The SPPF is situated in the forests of Mt Siburan. Haribon Foundation (2004) identified two DENR special projects within the same municipality, particularly: 1) the Mindoro Pines Seeds Production Area, and 2) the FORI Experimental Forest Area.

Boundary overlaps exist between many tenurial instruments, which imply a complication of land use management and potential conflicts in jurisdiction (Figure 8). Notable overlaps occur between ancestral domains, which are sprawled across Mindoro Island, and protected areas. Fortunately, both the NIPAS Act and the IPRA, the supporting legal frameworks of both tenurial instruments, contain provisions for the harmonious management and planning of areas classified under both protected areas and ancestral domains, particularly on ancestral land recognition in protected areas and natural resources management with ancestral domains.

Mining tenements, which are similarly applied across many areas on Mindoro, have extensive overlaps with CBFM areas in Bulalacao, Mindoro Oriental; with some portions of identified protected areas (such as Mts Iglit-Baco National Park, F.B. Harrison GBRS, and Mt Kadangyasan Forest Reserve); and most especially ancestral domains, which can result in potential conflicts. Other overlaps occur between ancestral domains and CBFM areas, particularly within the municipalities of Bulalacao and San Teodoro, Mindoro Oriental. Portions of SPPF in Sablayan, Mindoro Occidental are also subjected to mining applications, particularly under the Kanlaon Mining Corporation FTAA application.

Mindoro Island constitutes one of the major biogeographic regions in the country, exhibiting high levels of species richness and a diverse range of habitats. It is home to the critically endangered Mindoro Dwarf Buffalo (*Bubalus mindorensis*), locally known as the *"tamaraw"*, which is found only in Mindoro and is considered as the largest endemic mammal in the Philippines (IUCN 2010b). For birds alone, six endemic species have been recorded on the island out of the total 576 species found in the country (Haribon Foundation 2004, Ong *et al*. 2002). Apart from its wealth of biological resources, it is also the home of the indigenous Mangyan tribes, making the island one of the important cultural centers of the Philippines.

The biogeography of the Philippine archipelago falls into 15 biomes, based on the floral, faunal, and geological composition of geographical areas in the country (Simpson and Bugna 2001). Mindoro Island is a unique biogeographic zone in itself compared to the rest of the islands in the country. According to BirdLife International, Mindoro is also one among seven major Endemic Bird Areas in the country, hosting 10 restricted-range bird species, of which five species are concurrently globally threatened and endemic (Stattersfield *et al*. 1998, Mallari *et al*. 2001).

Table 5. Terrestrial conservation priorities in Mindoro Island (Source: Ong *et al*. 2002)

No,	**Conservation priorities**	**Priority level**	**Conservation efforts**
1	Iglit and Baco Mountains	Extremely high critical	Moderate
2	Mt. Hinunduang	Extremely high critical	Moderate
3	Mt. Halcon	Extremely high critical	Moderate
4	Puerto Galera	Extremely high critical	Moderate
5	Sablayan	Extremely high critical	Moderate
6	Lubang Island	Very high	Moderate
7	Lake Naujan National Park	Very high	High
8	Mt. Calavite Wildlife Sanctuary	Very high	High
9	Bogbog, Bongabong, and Mt. Hitding	Insufficient data	Low
10	Malpalon	Insufficient data	Insufficient data

Mindoro is recognized by international conservation organizations such as the IUCN, BirdLife International, the World Conservation Monitoring Centre, among others, as one of the world's 10 highest priority areas for conservation concerns in terms of both numbers of threatened endemic species and degrees of threat (DENR and UNDP 2006).
Mindoro's biodiversity is threatened by anthropogenic activities such as land conversion, illegal wildlife hunting, and timber poaching, and large-scale mining applications. Most of the original forest cover of the island has already declined in the last century, as shown by the forest cover maps of the ESSC (1999).

Through the PBCPP, several terrestrial conservation priority areas were identified in Mindoro Island under different priority levels and degrees of conservation efforts or interventions (Figure 9, Table 5). Five areas were identified as extremely high critical, three under very high, and two areas have insufficient data. All areas deemed as extremely high critical priority have moderate levels of conservation-related initiatives. Two areas: Lake Naujan and Mt Calavite, which are listed under very high priority both experience high levels of conservation interventions compared to extremely high critical priorities. Areas with insufficient data could be treated as top priorities for research interventions to determine their priority level.

In Mindoro, a total of 10 KBAs have been identified, which are concurrent with identified IBAs on the island. Table 6 shows a total of eleven priority conservation areas that were identified based on the studies by Mallari *et al*. (2001), Ong *et al*. (2002), and CI-Philippines-DENR-Haribon (2006). The matrix shows a high agreement among the studies on IBA, PBCPP, and KBA in terms of identified conservation priority areas for Mindoro (particularly areas #1-10, except for Apo Reef which is not included under PBCPP; and with the exception of

Lubang Island which was identified as a priority only under the PBCCP). (Under the PBCPP, Lubang Island was distinguished as a separate terrestrial biogeographic region. It was determined as a priority conservation area for taxonomic groups such as mammals, amphibians and reptiles, and arthropods.) In the 2009-updated KBA map, marine KBAs have been included particularly in Puerto Galera and Lubang Island, which conforms to the PBCPP of which the identified marine conservation priorities in Mindoro include the Verde Island Passage (high) and Tablas Strait (very high).

Table 6. Matrix of identified conservation priority areas in Mindoro vis-à-vis MBCFI priority sites.

No.	**Conservation priority areas**	**IBA** (Mallari *et al.* 2001)	**PBCPP** (Ong *et al.* 2002)	**KBA** (CI-Phils *et al.* 2006)	**MBCFI**
1	Mt. Calavite Wildlife Sanctuary	X	X	X	X
2	Puerto Galera (incl. Mt. Malasimbo)	X	X	X	X
3	Mt. Halcon	X	X	X	X
4	Lake Naujan National Park	X	X	X	X
5	Iglit and Baco Mountains	X	X	X	
6	Siburan (or Sablayan)	X	X	X	X
7	Malpalon	X	X	X	
8	Mt. Hitding (incl. Bogbog and Bongabong)	X	X	X	
9	Mt. Hinunduang	X	X	X	X
10	Apo Reef Marine Natural Park	X		X	X
11	Abra de Ilog				X
12	Bulalacao				X
13	Ilin Island				X
14	Lubang Island		X	X	

Priority conservation sites initially determined by MBCFI have been juxtaposed with identified conservation priorities from other studies (Table 6). A map overlay of the different conservation priorities is also presented (Figure 9). Of the 10 identified sites of MBCFI, seven sites correspond to IBAs, KBAs, and PBCPP areas. Three sites, namely: Iglit-Baco mountains, Mt. Hitding, and Malpalon, are not included as MBCFI conservation priorities. It should be noted that the priority levels of the latter two sites have not been determined due to insufficient data; conservation efforts are also either low or unknown. Other priority sites determined by MBCFI that do not correspond to the identified priorities of other studies include Abra de Ilog, Bulalacao, and Ilin Island. The two sites, Abra de Ilog and Bulalacao, still form part of the greater Mindoro corridor (as delineated in Ong *et al*. (2002).

Mining tenements overlap with eight of 10 identified KBAs except Mt Calavite Wildlife Sanctuary and Apo Reef Marine Natural Park (Figure 10). About 95,378 hectares of Mindoro's forests (49.6% of the total forest cover of Mindoro) are under mining tenements—almost half of the island's remaining forests. Mining tenements are found over each of Mindoro's major watersheds (Figures 11 & 12, Table 7). Mining tenements cover about 217,942 hectares (or 30.4%) of the total area of Mindoro's major watersheds, while 71,660 hectares (46.1%) of forests within these major watersheds are covered within the same mining instruments.

Table 7. Major watersheds within Mindoro Island showing computed forest area and mining tenements coverage.

Watershed name	**Watershed area (ha.)**	**Forest area (ha.)**	**Watershed area under mining tenements (ha.)**	**% of watershed within mining tenements**	**Area of forests within watershed & covered by mining tenements**	**% of forest within mining tenements**
1. Magasawang Tubig	140,222	83,956	52,568	37.5	45,172	53.8
2. Busuanga	55,591	1,717	6,156	11.1	-	-

3. Bongabong	55,497	13,110	12,398	22.3	2,488	19.0
4. Amnay	53,880	11,668	17,115	31.8	6,411	54.9
5. Rayusan	44,122	12,086	16,262	36.9	5,208	43.1
6. Butas-Lumangbayan	44,028	3,028	1,505	3.4	1,080	35.7
7. Cagaray	42,930	3,662	17,986	41.9	122	3.3
8. Pinagsabaran	38,879	1,012	25,233	64.9	1,012	100.0
9. Lumintao	36,991	1,801	25	0.1	-	-
10. Mongpong	32,305	7,721	8,939	27.7	854	11.1
11. Pagbahan	31,492	4,253	14,442	45.9	3,885	91.4
12. Pula	24,149	1,230	4,203	17.4	741	60.2
13. Polo-Salagan	24,009	816	2,172	9.0	189	23.1
14. Wasig	16,382	-	12,416	75.8	-	-
15. Labangan	14,227	1,315	3,530	24.8	738	56.1
16. Abra de Ilog	13,438	2,527	10,897	81.1	1,654	65.5
17. Balete	13,153	1,563	1,410	10.7	74	4.8
18. Anahawin	12,304	676	308	2.5	30	4.4
19. Maragooc	11,604	1,568	1,747	15.1	140	8.9
20. Sumagui	11,211	1,697	8,630	77.0	1,697	100.0
TOTAL	716,413	155,406	217,9412	30.4	71,660	46.1

The Mindoro Nickel Project, situated over the highlands of the municipality of Sablayan and portions of Victoria, is owned by Intex Resources with local partner subsidiaries—Aglubang Mining and Alag-ag Mining Corporations. It consists of one approved MPSA and three MPSA applications with a total mine operation area of 11,216.60 hectares. The project is situated over high elevation forests, which comprise at least 70% of its total area, and is in conflict with portions of two identified conservation priority areas specifically Mt Halcon and Mts Iglit-Baco (Figure 10). The project is also situated squarely over the Magasawang Tubig River Basin and, more notably, the headwaters of Magasawang Tubig River, which drains out to the lowland areas of Naujan and Calapan City (Figure 11).

The Provincial Government of Mindoro Oriental enacted a 25-year mining moratorium in the province in 2002, particularly Provincial Ordinance No. 001-002 which is pursuant to the Local Government Code of 1991 (RA 7160), which empowers local government units to enact laws to protect the environment and mineral resources. Following a hunger strike conducted by Mindoro locals and civil society groups in November 2009 at the DENR in Manila against the issuance of an environmental compliance certificate to Intex Resources, the Provincial Government of Mindoro Occidental similarly passed Provincial Ordinance No. 34-09 declaring a 25-year large-scale mining moratorium in the province. (The DENR temporarily revoked the mining clearance given to Intex Resources for the Mindoro Nickel Project as a result of the people's hunger strike.)

b. Socio-Economic Characteristics

Based on the 2007 Census of Population conducted by NSO, the provinces of Mindoro Occidental and Oriental have a total population of 421,952 and 735,769, respectively. These numbers also rank 3rd and 1st among the provinces of Region IV-B (with Palawan ranking 2nd). Table 8 reflects the total population and population density per municipality in 2000 and 2007, the population growth rate for each municipality from 2000 to 2007, and potential population pressure computed using Fisher and Christopher (2007), which is discussed further later. The population growth rates from 2000 to 2007 of Mindoro Occidental and Oriental are 1.44 and 1.06 at the provincial level, respectively. These rates are below the identified growth rates at the regional level (1.49) and at the national level (2.04). The population trend is generally increasing for all municipalities, while growth rates vary from 0.25 to 3.45.

Table 8. Total population and population density in 2000 and 2007, and population growth rate from 2000 to 2007 per municipality in Mindoro Island (Source: NSO 2000a, 2007).

Province	Municipality	Land area (ha.)	Total population		Population density		Population growth rate (2000-2007)	Potential population pressure
			2000	2007	2000	2007		
Mindoro Occidental	Abra de Ilog	58,796	22,212	25,152	0.38	0.43	1.73	0.74
	Calintaan	31,399	23,503	26,779	0.75	0.85	1.81	1.54
	Looc	12,821	9,132	11,310	0.71	0.88	2.99	2.63
	Lubang	12,491	22,896	28,267	1.83	2.26	2.95	6.67
	Magsaysay	35,222	28,740	30,459	0.82	0.87	0.80	0.70
	Mamburao	30,962	30,378	34,487	0.98	1.11	1.76	1.95
	Paluan	52,870	12,023	13,718	0.23	0.26	1.83	0.48
	Rizal	18,870	29,785	32,065	1.58	1.70	1.02	1.73
	Sablayan	230,336	63,685	70,506	0.28	0.31	1.41	0.44
	San Jose	39,310	111,009	118,807	2.82	3.02	0.94	2.84
	Santa Cruz	59,670	26,887	30,402	0.45	0.51	1.71	0.87
Mindoro Oriental	Baco	29,069	30,167	34,127	1.04	1.17	1.71	2.00
	Bansud	24,657	35,032	35,664	1.42	1.45	0.25	0.36
	Bongabong	48,054	59,477	61,127	1.24	1.27	0.38	0.48
	Bulalacao	32,470	27,698	30,188	0.85	0.93	1.19	1.11
	Calapan City	24,651	105,910	116,976	4.30	4.75	1.38	6.56
	Gloria	27,492	38,667	40,561	1.41	1.48	0.66	0.98
	Mansalay	50,547	39,041	43,974	0.77	0.87	1.65	1.44
	Naujan	39,759	83,892	90,629	2.11	2.28	1.07	2.44
	Pinamalayan	24,347	72,951	77,119	3.00	3.17	0.77	2.44
	Pola	10,884	31,938	32,635	2.93	3.00	0.30	0.90
	Puerto Galera	22,577	21,925	28,035	0.97	1.24	3.45	4.28
	Roxas	8,867	41,265	46,711	4.65	5.27	1.72	9.06
	San Teodoro	34,244	13,806	15,039	0.40	0.44	1.19	0.52
	Socorro	18,525	37,176	38,052	2.01	2.05	0.32	0.66
	Victoria	24,965	42,873	44,932	1.72	1.80	0.65	1.17
	TOTAL	1,003,854	1,062,068	1,157,721				

San Jose in Mindoro Occidental is considered as the most populous municipality, having the highest total population both in 2000 and 2007. It is followed by the City of Calapan in Mindoro Oriental similarly for both years (Figure 13, Table 8). Naujan, Pinamalayan, and Sablayan follow as the next most populous municipalities. Looc municipality in Lubang Island is the least populous town in Mindoro.

In terms of population per unit area (population/hectare of municipality), the municipality of Roxas exhibited the highest population density both in 2000 and 2007, followed by Calapan City and San Jose (Figure 14, Table 8). (Densely populated areas are concentrated in northeast Mindoro, particularly from Calapan City down to Pinamalayan; Roxas at the southeast end; and San Jose and Rizal at the southwest part.) Note that Sablayan, although it ranks among the most populous municipalities, also ranks among the lowest in terms of population density, which can be directly attributed to its vast land area (i.e., the largest in Mindoro Island). In contrast, Pola and Roxas fit among the lowest in terms of total population, but rank high in terms of density due to their smaller land area. Calapan City is consistent as both high in terms of total population and population density.

Areas with high growth rates are situated mainly at the northwest portion of Mindoro, including Lubang Island (Figure 15, Table 8). Although most municipalities of Mindoro Occidental (specifically the municipalities of Paluan, Abra de Ilog, Looc, Lubang, Mamburao, Santa Cruz, Sablayan, and Calintaan) have relatively low population densities, they nevertheless exhibited high population growth rates compared to the densely populated centers. (Only the municipality of Magsaysay has both low population density and growth rate.) With a generally increasing population trend for all municipalities in Mindoro, these high population growth areas are projected to catch up soon as densely populated areas.

Road networks generally connect most of the different municipalities in Mindoro, although the type of roads (e.g., concrete, dirt) limit the accessibility and travel time to reach some municipalities. Circumnavigation around the island via land transport is possible although certain segments are either impassable or difficult to access during the rainy season (such as the provincial roads connecting Mansalay and Bulalacao, and Abra de Ilog and Puerto Galera). Road networks in Mindoro Oriental are much denser (or more developed) compared to Mindoro Occidental. Figures 14 & 15 show that much denser roads networks also coincide with areas of high population density (e.g., San Jose at the southwest, the municipalities found northeast from Calapan City to Pinamalayan). In time in can be shown that high population growth areas can soon improve their road facilities in support of trade and commerce.

Mindoro is also connected to other parts of the Philippines by air and sea transports. Mindoro Occidental has five seaports located at Abra de Ilog, Lubang, Mamburao, Sablayan, and San Jose. It also has three medium-sized airports located at San Jose, Mamburao, and Lubang, which are suitable for regular general aviation traffic and have some scheduled regional airline services. The main points of entry include the wharf at Abra de Ilog (which accommodates passenger-cargo ships mainly from Batangas) and the airport at San Jose (which provides the air link with Manila). On the other hand, Mindoro Oriental is accessible from mainland Luzon via its main points of entry at the seaports at Calapan City and Puerto Galera; it is also connected by ship to Panay Island in the Visayas through Roxas port. Mindoro Oriental has three small airports located in Calapan City, Pinamalayan, and near Roxas, which are suitable for light aviation traffic but have no scheduled airline services.

Mindoro's two provinces are largely agriculture-based economies. Based on NSO's 2000 Family Income and Expenditures Survey, 53% and 43% of the total number of families in Mindoro Occidental and Mindoro Oriental, respectively, derive their income solely from agricultural-related activities (e.g., wages, entrepreneurial engagements) (NSO 2000b). Rice production is the leading agricultural activity in both provinces, and the main source of seasonal employment. Based on NSO's 2002 Census of Agriculture, lands devoted to rice production are estimated at 66,104 and 82,953 hectares in Mindoro Occidental and Mindoro Oriental, respectively (NSO 2004). The same 2002 Census report also tabulates the area of farmlands with irrigation facilities at 37,108 and 69,441 hectares for Mindoro Occidental and Oriental, respectively, although how much of these areas were situated in rice production areas have not been distinguished by the report. The higher proportion of lands devoted to rice production (including irrigation facilities) in Mindoro Oriental may be correlated to its shorter dry season and generally even rain period due to the type of climate it experiences; hence making irrigation more feasible (compared to Mindoro Occidental).

Given this high percentage of the families engaged in rice production, it should be noted that cultivated lowland areas account for only one-fifth (19.40%) of the total land area of Mindoro, and majority of these areas are situated in Mindoro Oriental province. The densely populated municipalities, especially in Mindoro Oriental, are observed to have high coincidence with lowland cultivated areas. Municipalities such as Sablayan, which have high total population but have limited cultivated lowland areas, suggest that rice production activities are also possibly undertaken in upland areas.

For Mindoro Oriental, Moya and Castillo (2006) reports that rice occupies 59% of cultivated area in the province, and 66% of the total rice production area of the province (~80,000 hectares) in 2002 were irrigated, which contributed about 69% of total production because of higher yields than rain-fed areas. Irrigated areas also grew two crops of rice per year, whereas rain-fed areas cultivated 1.7 crops of rice per year. Rice production in Mindoro Oriental more than tripled from 1970 to 2002, the increase was largely attributed to expansion of harvested areas and more than a doubling of yield per hectare (from 1.54 tons per hectare in 1970 to 3.32 tons per hectare in 2002).

Considerable areas of Mindoro's land devoted to rice cultivation, however, are still rain-fed. Seasonal climate variability and the occurrence of El Niño Southern Oscillation (ENSO) phenomenon affect resource-constrained farmers whose livelihoods are greatly dependent on the changing seasons. This is most evident among rain-fed farmers who rely exclusively on rainfall to irrigate their crops (Reyes *et al*. 2009). (Note: ENSO has two major phases: the El Niño or warm event and the La Niña or cold event. El Niño conditions lead to drier seasons due to suppressed tropical cyclone activity and weaker monsoons; La Niña is characterized by above normal rainfall and longer rainy seasons. In the Philippines, according to Reyes *et al*. (2009), the destructive power of ENSO was clearly documented during the 1997-1998 El Niño/La Niña episode when a total of Php 7.6 billion in rice and corn production losses were incurred.) High dependence on agriculture signifies a high vulnerability to changes in the environment.

Mindoro's watersheds, which are vital aquifer recharge areas for irrigating cultivated lands, are subject to continuing modifications, and even more threatened by numerous mining applications. Loss of forest cover affects not only decreases the watersheds' stream flow dependability but also increases flood peaks and degrades water quality (David 2000). Many of the island's river systems could not meet the required volume of water to make irrigation systems feasible; this is mainly attributed to denuded watersheds. The inadequacy of irrigation facilities restricts rice production only during the rainy season (July to October) while other non-water intensive crops are grown during the dry season; however, climate variability, on the other hand, is another major concern for rainfall-dependent farms. Rice farming in Mindoro is also confronted by the high cost of production, particularly the high prices of farm inputs.

Fisher and Christopher (2007) looked at potential population pressure as an indicator to show that poverty reduction depends on living resource conservation (i.e., that poverty is innately connected with life-supporting ecosystems). Potential population pressure is defined as the population growth rate multiplied by population density (Fisher and Christopher 2007), which recognizes that high population growth rate may not have a huge effect on local ecosystems if the initial population density is low. Hence, this indicator attempts to show possible future pressures. In Mindoro, municipalities with the greatest potential population pressure on natural resources (such as forests, water, and land) are Roxas, Lubang, Calapan, Puerto Galera, San Jose, and Looc (Figure 16, Table 8).

It may be argued that an increasing population trend for all municipalities in Mindoro can potentially exert future pressure on dwindling natural resources. These pressures are mainly driven by increasing agricultural production requirements, improving livelihoods and incomes, the provision of basic needs, or just the need to survive. Remaining forests, for example, in municipalities with great potential population pressure may face a grim future without appropriate resource management interventions to address increasing—and even competing—resource needs and uses. Sustainable development, as defined by the Brundtland Report published by the United Nations World Commission on Environment and Development in 1987, is "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." Hence, to sustain development initiatives in Mindoro, the simultaneous pursuit of interdependent and mutually reinforcing pillars—social equity, economic prosperity, and environmental quality (or the *triple bottom line*)—should be addressed.

The overall poverty index map of Mindoro Island reveals the disposition (or level of development or poverty) of each municipality from a socio-economic standpoint (Figure 17, Annex 6). The index is mainly based on a compendium of available socio-economic indicators including housing, sanitation, education, health, and economic characteristics. Puerto Galera and Lubang ranked among the highest, which may be regarded as the most developed municipalities in Mindoro; Bulalacao, Abra de Ilog, and Mansalay ranked among the lowest, which, on the other hand, may be regarded as the least developed.

Of the total 26 municipalities, 13 ranked higher than the island average based on the overall poverty index, of which 9 belonged to Mindoro Oriental province (Annex 6); 11 ranked lower than the average, 6 of which belonged to Mindoro Occidental province; and 2 ranked at the average level (specifically Mamburao and Socorro). Looc and Lubang (in Lubang Island), fared well on the overall index compared to other municipalities in mainland Mindoro. All the mainland municipalities of Mindoro Occidental fared moderately close to the index average, except for Abra de Ilog. For Mindoro Oriental, the least developed municipality is Bulalacao followed by Mansalay—both are situated in the poorly accessible southern portion of the island.

Figure 17 also shows the association of poverty and gaps in road infrastructure in Mindoro. Areas with a dense road network, such as the island's northeast lowlands, are depicted with lower incidence of poverty. High poverty incidence areas, particularly: Bulalacao, Abra de Ilog, and Mansalay, all tend to lack enough good road infrastructures. The absence of roads means longer travel times and poorer access to markets, employment, health services, and education (Henninger and Snel 2002).

If the overall poverty index provides an indication of the level of development of a municipality in socio-economic terms, it similarly identifies target priorities for interventions, and directly focuses these efforts starting from the least developed to the moderately developed areas. In this case, the municipalities of Bulalacao, Abra de Ilog, and Mansalay rank high on the priority areas for intervention (e.g., budget allocation and planning, disaster risk reduction, natural resource and watershed management).

Conservation priority areas (shown in terms of priority levels) were superimposed over the poverty index results (Figure 18). These conservation priority areas delineate where species richness is highest (which highlights endemicity and, therefore, irreplaceability) and indicate where biodiversity is most threatened (which highlights vulnerability) (also refer to Figure 9, Table 4). (Note: Eken *et al*. (2004) elaborates on irreplaceability and vulnerability, which are the two key criteria in the identification of Key Biodiversity Areas.) Areas where high poverty incidence coincides with conservation priorities, particularly Mt Hinunduang and Puerto Galera, may indicate areas in which poor people likely have no other choice than the unsustainable extraction of resources, in turn threatening biodiversity. Conservation priorities, including Sablayan, Iglit-Baco mountains, and portions of Mt Halcon and Lake Naujan, are situated in areas with moderate incidence of poverty, which similarly merits attention. Lubang Island may be an exception where an Extremely High Critical conservation priority area coincides with municipalities of rather low poverty incidence.

Populations in high biodiversity areas will continue to increase globally and these populations will be heavily dependent upon local food production and resource extraction (Fisher and Christopher 2007). Population growth in areas of high resource extraction has an obvious pressure effect on ecosystems (McNeely and Scherr 2003) and exacerbates deforestation rates (Deacon 1994). Nelson and Chomitz (2004) similarly argue that deforestation leads to significant hydrological disturbance (in addition to biodiversity loss); and forest loss can be associated with landslides, can increase the risk of flooding, and can lead to reduction in dry season water flows, erosion, and downslope sedimentation.

The analysis of Nelson and Chomitz (2004) identified important rules of thumb concerning hydrological disturbances due to deforestation: (a) risks such as flooding are greater in smaller watersheds, those under 100 km^2 (or 10,000 hectares); (b) risks are greater when larger proportions of the watershed are subject to deforestation; and (c) risks are greater on steeper slopes. Looking at Mindoro's topography, forests, and major watersheds (Figures 6 & 7, Tables 4 & 7), none of its major watersheds fit the criteria under the first rule since all are above 100 km^2. The proportion of forests within watersheds, however, is all below 30% (averaging 21.69%), except Magasawang-Tubig River Basin. Steep slopes also characterize huge areas of these watersheds (in fact 66% of Mindoro's terrain is described as moderately sloping to mountainous). The spatial variation in precipitation in Mindoro indicated higher amounts of rainfall across the island except in the lowlands of the northeast; high precipitation areas are congruent with watersheds with low proportions of forest cover, as well as municipalities with moderate to high poverty incidence levels. These compounding factors entail higher landslide risk, and greater levels of erosion and sedimentation. Note that a staggering 46% of forests within major watersheds are also under threat from various forms of mining tenements.

Another aspect of correlation is the coincidence of high poverty incidence areas with geographical restrictions such as rough topography, particularly in the context of agricultural production (Figures 4 & 18). Agricultural (if not, rice) production in lowland areas is associated with higher yield (due to easier market access, better soil capabilities), which translate to higher household income. Areas of high poverty incidence (e.g., Bulalacao, Mansalay, and Abra de Ilog) are characterized by rugged terrain, steep slopes, and poor accessibility, which make lower yields from agricultural production a given.

Looking at the overall poverty index matrix for the whole of Mindoro Island (Annex 6), the top 3 indicators include: Households (HH) with access to safe drinking water (0.72); elementary school attendance of children ages 6 to 12 years old (0.68); and HH with access to sanitary toilets (0.64). On the other hand, the bottom 3 indicators include: proportion of overseas Filipino workers (OFWs) to total number of HH (0.36); HH with electricity (0.38); and head of HH graduated from high school at least (0.48).

On the proportion of housing units occupied by households that are classified as made of strong roof materials, a roof is considered made of strong material if it is made of either galvanized iron, aluminum, concrete or clay tile, half galvanized-half concrete, or asbestos (Figure 19). Of the total 26 municipalities, Annex 6 showed that 14 ranked higher than the island average for HH with dwelling units constructed with strong roof materials, of which 10 belonged to Mindoro Oriental province; 10 ranked lower than the average, 6 of which belonged to Mindoro Occidental; and 2 ranked at the average level (specifically Rizal and Roxas). Nine municipalities, namely: Baco, Calapan, Looc, Lubang, Naujan, Puerto Galera, San Jose, Socoro, and Victoria, ranked among the highest in terms of HH with dwelling units with strong roofs; the most developed area being the City of Calapan. Again, both municipalities on Lubang Island scored well on this component index compared to other municipalities on the mainland. Bulalacao and Mansalay ranked as the lowest for this indicator.

On the proportion of housing units occupied by households that are classified as made of strong outer wall materials, an outer wall is considered made of strong material if it is made of concrete, brick, stone, wood, half concrete-half wood, galvanized iron, asbestos, or glass (Figure 20). Of the total 26 municipalities, Annex 6 showed that 14 ranked higher than the island average for HH with dwelling units constructed with strong wall materials, of which 9 belonged to Mindoro Oriental province; 11 ranked lower than the average, 6 of which belonged to Mindoro Occidental; and 1 ranked at the average level (specifically Bansud). Four municipalities, namely: Calapan, Looc, Lubang, and Pinamalayan, ranked among the highest in terms of HH with dwelling units with strong walls. Again, the City of Calapan is the most developed area, while both municipalities on Lubang Island similarly scored well on this component index. Three municipalities ranked among the lowest, particularly Bulalacao, Mansalay, and San Teodoro; Bulalacao is the worst off for this indicator.

In its 2009 World Development Report, the World Bank discussed the concept of distance as an economic, not Euclidean, concept. Distance was referred to as "the ease or difficulty for goods, services, labor, capital, information, and ideas to traverse space." Better road connections, for example, shorten travel time and the distance to economic centers, creating larger agglomerated areas. Because of good roads and easier access to markets, villages close to economic centers generate as much activity as the economic center itself, and the well-connected periphery becomes part of the agglomerated area (World Bank 2009). Locations close to markets have a natural advantage; distance to economic density affects spatial movements in goods, services, information, knowledge, and people.

In the case of Mindoro, proximity to the City of Calapan creates positive economic spillovers such as influence over neighboring municipalities to improve housing standards (e.g., utilizing better roof and wall materials since the proximity to a center of economic activity eventually improves economic capacity of households and their living standards). Similarly, other economic centers such as Roxas, Mamburao, and San Jose, have apparently fared well on both component indices, although their neighboring municipalities have yet to benefit economically from their proximity to these centers.

For HH that have access to electricity, the island average for this indicator is the second lowest (0.38) for all 10 indicators (Figure 21, Annex 6). Four municipalities, namely: Bulalacao, Pinamalayan, Mansalay, and Santa Cruz ranked among the lowest; only the City of Calapan ranked at the highest level (as the most developed) for this indicator. Half of the total number of municipalities ranked higher than the average, 10 of which belonged to Mindoro Oriental. Households from the municipalities of Mindoro Occidental, therefore, only range from moderate to lowest level of access to electricity.

In terms of HH with access to sanitary toilet facilities, the island average is the third highest (0.64) for all 10 indicators (Figure 22, Annex 6). Fifteen municipalities scored higher than the island average, of which 9 belonged to Mindoro Oriental province, and with 6 municipalities ranking among the highest, namely: Lubang, Naujan, Puerto Galera, Rizal, San Jose, and Calintaan. Bulalacao ranks as the worst off for this indicator.

For HH that have access to potable water, the island average for this indicator is the highest (0.72) among all 10 indicators (Figure 23, Annex 6). Fourteen municipalities scored higher than the island average, of which 11 municipalities ranked among the highest; ten ranked lower than the average; and 2 at the same level as the average (namely Abra de Ilog and Maburao). Households from the municipalities of Mindoro Occidental range from moderate to highest level of access to safe drinking water. Three municipalities belonging to Mindoro Oriental ranked among the lowest, namely: Calapan, Victoria, and Gloria (the worst off for this indicator). Water supply and the quality of water largely depends on the integrity of watersheds. The continued access of Mindoro's constituents to available and safe drinking water, therefore, is highly correlated to adequate forest cover within its watersheds.

For HH with heads that are at least high school graduates, the island average for this indicator is the third lowest (0.48) for all 10 indicators (Figure 24, Annex 6). Eleven municipalities ranked lower than the island average, with five municipalities scoring among the lowest, specifically: Abra de Ilog, Bulalacao, Pola, Baco, and Paluan. Fourteen municipalities ranked higher than the island average, of which three ranked among the highest, namely: Calapan, Victoria, and Puerto Galera.

Leading areas of dense economic activity such as the City of Calapan (trade and commerce) and Puerto Galera (especially for tourism), through their market opportunities creates incentives that attract skilled workers and firms to move there. Labor migration from rural areas to market centers occur, and people moving to economically dense areas contribute to production and boost their incomes (World Bank 2009), and eventually even increase living standards. The high presence of HH heads that have completed higher levels of education may be construed as the movement of skilled workers to market centers. UNDP (2010) also found that where the head of the household has some form of educational attainment, the poverty levels for the household are lower.

An Overseas Filipino Worker (OFW) is defined as a Filipino who is presently and temporarily out of the country to fulfill an overseas work contract for a specific length of time, or who is presently at home on vacation but still has an existing contract to work abroad (Quinto and Perez 2004). According to the stock estimate of Filipinos overseas as of 2004 by the Commission on Filipinos Overseas, the Philippines is considered to be one of the largest migrant-sending countries with almost 8.1 million Filipino workers abroad. Filipinos who decide to work abroad mainly seek better employment opportunities due to issues of unemployment and poverty in the country.

On the percentage of HH with OFWs, the island average for this indicator is the lowest (0.36) for all 10 indicators (Figure 25, Annex 6). Fourteen municipalities scored lower than the island average, of which 8 belonged to Mindoro Occidental province; twelve municipalities scored higher than the average. Ten municipalities ranked among the lowest including: Abra de Ilog, Bansud, Bulalacao, Calintaan, Magsaysay, Pola, Rizal, Sablayan, San Jose, and Santa Cruz; of these, 7 belong to Mindoro Occidental. Two municipalities ranked among the highest, specifically Looc and Lubang, which are both situated on Lubang Island. The low turnout for this indicator may mean that most households in Mindoro do not have access to, or could not access opportunities for overseas work. This indicator does not intrinsically mean that HH without OFWs are poor, but rather economic benefits derived from overseas work are not accessed by most households in the island, and therefore do not contribute to increasing the level of income of households.

In terms of education indicators, available data on elementary and high school attendance were used. On the proportion of elementary school attendance of children ages 6 to 12 years old, the island average for this indicator is the second highest (0.68) for all 10 indicators (Figure 26, Annex 6). Twelve municipalities ranked among the highest, 10 of which belonged to Mindoro Oriental province. The two municipalities, Lubang and Looc, situated on Lubang Island ranked among the highest for municipalities belonging to Mindoro Occidental. Three municipalities ranked among the lowest, particularly: Abra de Ilog, Bulalacao, and Paluan.

On the proportion of high school attendance from ages 13 to 16 years old, seven municipalities ranked among the highest (Figure 27, Annex 6). These municipalities, namely: Lubang, Calapan, Pinamalayan, Gloria, Victoria, Looc, and Gloria, also ranked consistently among the highest in terms of elementary school attendance. Bulalacao, on the other hand, ranked consistently among the lowest on both elementary and high school attendance. It is interesting to note the high correlation between the high turnouts of school attendance (at both levels) and OFW percentage in the two municipalities of Lubang Island.

On infant mortality rates, 15 municipalities scored higher than the island average, 10 scored lower than the average, and 1 at the same level as the average (Figure 28, Annex 6). Seven municipalities ranked among the highest, including Puerto Galera, Abra de Ilog, Bulalacao, Looc, Naujan, Sablayan, and Victoria. In terms of the lowest, two municipalities were included: Socorro and Calapan City. (Infant mortality rates were computed by the total infant deaths divided by the total live births multiplied by 1000.)

On compliance with the United Nations Millennium Development Goal (MDG) targets, Mindoro Island ranks high on the following four indicators: access to sanitary facilities (basic sanitation: goal 7, target 7c); elementary school attendance (net enrollment ratio in primary schooling: goal 2, target 2a); access to potable water (safe drinking water: goal 7, target 7c); and reducing infant mortality rate (infant mortality rate: goal 4, target 4a). Four of 10 indicators utilized in poverty mapping are aligned with the UN MDGs. UNDP (2010) reports that the MDGs are interlinked—progress in one goal supports progress in others; hence investing across all MDGs was encouraged for the greatest impact. One of the most important synergies between MDGs highlighted by UNDP involves environmental sustainability, which is needed to achieve the MDGs and sustain progress. Among the examples include: child mortality was high among households with poor access to clean water and sanitation facilities; environmental deterioration was directly correlated with infant mortality; the provision of water closer to homes and low-cost electricity from sustainable sources saved time for women, who can engage in education and entrepreneurial activities; and evidence showed literacy can be significantly higher in areas with electricity compared to those without.

3. Summary of Significant Findings of Some Ecosystems Analyses

Millennium Ecosystem Assessment

The 2005 Millennium Ecosystem Assessment (MEA) is a United Nations study considered as the first global survey of ecological services. It sought to evaluate the effects of ecosystem changes to human well-being. It classifies ecosystem services into four categories: provisioning (food, timber, fuel); regulating (climate, water, disease regulation); supporting (nutrient cycling, photosynthesis, soil formation); and cultural services (aesthetic, spiritual, educational, recreational) (MEA 2005). While the value of provisioning services is relatively easy to calculate, attaching value to the regulating, supporting and cultural services is more complicated. They are, however, indisputably crucial to human well-being and as such should be given importance. They are also the services that stand to be affected by industries such as mining, which result in considerable ecosystems alteration and even irreversible damage.

MEA (2005) shows the strength of linkages between categories of ecosystem services and components of human well-being that are commonly encountered, and includes indications of the extent to which it is possible for socio-economic factors to mediate the linkage. The strength of the linkage and the potential for mediation differ in different ecosystems and regions. In addition to the influence of ecosystem services on human well-being, other factors—including other environmental factors as well as economic, social, technological, and cultural factors—influence human well-being, and ecosystems are in turn affected by changes in human well-being.

The MEA found that the unsustainable use of ecosystems, while providing benefits like increased food production, has resulted in significant harm to some groups of people and substantially diminished the benefits that future generations can obtain from ecosystems. In terms of ecosystem services, the value lost as a result of human activities ultimately lessens the net benefits obtained from them.

Over the past 50 years, human-driven ecosystem changes have occurred more rapidly than at any other time in history (MEA 2005). Humans are literally changing the face of the earth, leaving it more and more degraded for the coming generations. In the Philippines, roughly the same period saw the fastest rate of deforestation, with as much as 32% lost mainly due to large-scale logging and land conversion. Coupled with a similar depletion of mangrove forests (White and Cruz-Trinidad 1998, White and De Leon 2004), this has resulted in increased sediment outflow onto reefs, contributing to the destruction of as much as 70% of fisheries within 15 km from the shore (Burke *et al*. 2002).

The MEA study also found that approximately 60% (15 out of 24) of the ecosystem services evaluated are being degraded or used unsustainably. These services include capture fisheries, water supply, waste treatment and detoxification, water purification, natural hazard protection, regulation of air quality, regulation of regional and local climate, regulation of erosion, spiritual fulfillment, and aesthetic enjoyment. Capture fisheries and fresh water were particularly singled out as being utilized well beyond sustainable levels even at current demands.

Mining and Critical Ecosystems Initiative

Miranda *et al*. (2003) in the Mining and Critical Ecosystems Initiative of the World Resources Institute provided a framework to assess possible “no go” mining areas. The framework used three broad categories of indicators: vulnerability, which includes biological, environmental and social indicators; natural hazards; and other contributing factors like governance and mine practices. Two countries, Papua New Guinea and the Philippines, were used as case studies. The results of Miranda *et al*. (2003) showed that the Philippines is subject to multiple vulnerabilities and hazards, with mining claims overlapping with protected areas, high conservation value areas, and stressed watersheds. Issues like capacity of communities for informed decision-making, corruption, and ability of the government to enforce laws, also contributed to the vulnerability.

The framework showed an extent of the country's vulnerability to mining that would certainly warrant “no go” decisions even on areas that have no legal protection. Since much of the Philippines can be considered environmentally or socially sensitive, the potential impacts of poorly planned mining could be very costly to ecosystems and to communities who depend upon them for natural services (Miranda *et al*. 2003). Clearly, there is still much evaluation and extensive decision-making processes to be undertaken prior to pursuing mining activities to ensure that its potential impacts do not adversely affect ecosystems and communities.

Country Environment Analyses: Philippines

The Asian Development Bank (ADB), in its 2008 Country Environment Analysis of the Philippines, identified that the main environmental concerns with cumulative impact include loss of watershed integrity; unsustainable and inappropriate land use practices in upland areas; rapid population increase and urbanization; and degradation and exploitation of forests and coastal areas. The loss of biodiversity is attributed to these factors, and to ineffective management, lack of awareness on biodiversity, and poor enforcement of regulations.

An important observation by ADB identified that sectoral planning characterizes much of the planning done in the country. This fails to consider inter-sectoral issues, which consequently results in unnecessary inter-sectoral conflicts and provides little opportunity to weigh natural resource trade-offs. This lack of integrated planning can also result in conflicts with local governments, and in a failure to consider loss of biodiversity and ecological services (ADB 2008).

ADB (2008) furthermore stated that the Medium-Term Philippines Development Plan projects increasing growth rates in all sectors of the economy, which are heavily dependent on natural resources that are almost depleted (e.g., capture fisheries, forests, water resources). The sustainability of the economic growth envisioned by this development strategy, thus, is already implausible at the onset. Unless an integrated and ecosystem-based approach to planning and management is carried out, sustainable development will unlikely be achievable in light of the country's ailing natural resource base.

RA 7160 has provisions with major impact on devolution and the implementation of environment and natural resources (ENR) laws and regulations from the DENR to local governments. However, the devolution of ENR functions have been regarded as incomplete, mainly peripheral, those with low private sector investment interests, or those that were costly to perform. ADB (2008) thus recommended more, and better, resources and stronger coordination between DENR and the local governments will be needed to complete the devolution of ENR functions, with the DENR being more proactive and local governments more willing and able to accept management responsibilities. This process should improve understanding of devolution and affirm commitment to sustainable ENR management as a collective responsibility.

Economic Valuation of Natural Resources

The concept of economic valuation of natural resources, or resource valuation, refers to the attachment of economic values to natural resources and environmental services including those that are not usually accounted for by the market such as indirect uses and benefits. Ecosystems provide many services that affect human well-being (MEA 2005), yet their values are not taken into account, and even taken for granted. Attaching economic values to natural resources and ecosystem services comes from the need to view these resources in terms of their total economic value in order to make better decisions concerning sustainability and resource allocations (Rosales 2003, Samonte *et al*. 2007).

Resource valuation has been demonstrated to be useful in showing that beyond the preservation of habitats and wildlife is the preservation of critical ecosystem services and benefits that make sense even from a business perspective. One of the most easily illustrated ecological services is water regulation. Preserving watershed integrity, for example, results in a continuous and clean water supply without the added expense of creating reservoirs, water treatment plants or diverting (or even buying) water from elsewhere. Businesses and governments in several parts of the world (New York City government; Cape Town, South Africa; Cauca Valley, Colombia) have realized this, investing millions of dollars on forest protection to ensure water supply (The Economist 2005).

In the Philippines, resource valuation methods were used to assess the conservation significance of Samar Island Natural Park. The study was conducted to provide scientific basis for decision-making on competing land uses, as the area overlaps with a mineral reserve reported to contain the only bauxite deposits in the country. Valuation results estimated the biodiversity value of the Park at US$43.5 billion in 25 years, with a net present value of US$12.5 billion (Dalmacio 2003). This was more than double the estimated revenues from bauxite mining, which was pegged at US$21 billion.

In the Samar Island valuation study, water is the most valuable resource at US$30.7 billion over 25 years, with a net present value of US$8.8 billion. Estimated total water demand in 2000 is at 6,260 million cubic meters per annum, a figure that is projected to increase to 11,648 million cubic meters per annum in 25 years (Dalmacio 2003). Over 98% of this demand is used for agriculture purposes. Any harmful impact on water resulting from mining, therefore, would most likely affect agriculture and food security in Samar Island. With the island's extensive 25 major river systems, and the proposed mineral development area located at headwaters of these rivers, mining impacts are bound to be considerable, reaching an extent much farther than the area of the actual mining operations.

The results of the valuation study helped galvanize an island-wide campaign, which eventually led to the Presidential Proclamation 442 establishing the Samar Island Natural Park in April 2003. However, proposals have also been considered to excise 54,000 hectares from the Park for mineral development. The valuation study, while effective in campaign and information dissemination activities, was not given enough weight and used as basis for decision-making by the appropriate authorities. Nevertheless, the Samar example showed the potential of resource valuation as a tool for decision-making and even for people empowerment, as a heightened awareness of the value of their island's biodiversity spurred the people into acting to preserve it.

Other valuation studies done in the Philippines valued ecosystem services like landscape and seascape beauty, biodiversity conservation, watershed protection, carbon sequestration, and environmental waste disposal services (e.g., Rosales 2003, Bautista and Tan 2003, Samonte-Tan and Armedilla 2004). The results were used to develop market-based instruments for environmental services such as user fee systems, the proceeds of which were used to conserve the ecosystems rendering the service. The study by Samonte-Tan *et al*. (2007) on the economic valuation of coastal and marine resources in the Bohol Marine Triangle not only showed the net benefits generated from direct uses, but even economic values derived from the conduct of research and indirect uses.

D. Summary of Issues and Concerns

This section provides a summary of the issues concerning the competing resource uses, such as biodiversity and mining, based on the situation analyses presented in the previous section.

1. Absence of a land use planning framework

Boundary overlaps exist between many tenurial instruments in Mindoro Island, which imply a complication of land use management and potential conflicts in resource use priorities. Notable overlaps occur between ancestral domains, which are sprawled throughout Mindoro Island, and protected areas. Fortunately, both the NIPAS Act (RA 7586) and the Indigenous Peoples Rights Act (RA 8371), the supporting legal frameworks of both tenurial instruments, contain provisions for the harmonious management and planning of areas classified under both protected areas and ancestral domains, particularly on ancestral land recognition in protected areas and natural resources management with ancestral domains. Mining tenements, which are applied across many areas on Mindoro, have extensive overlaps with CBFM areas in Bulalacao, Mindoro Oriental; with some portions of identified protected areas (such as Mts Iglit-Baco National Park and F.B. Harrison), and most especially ancestral domains.

The lack of a national land use policy has resulted in this confusion on land utilization and also has, in several instances, resulted in negative effects among stakeholders. It is therefore imperative that policy makers pursue actions to address the complexities of the problems that arise from land use and land-related issues. The government's decision to pursue mining as a revenue-generating industry clashes with biodiversity-related concerns (PAWB 2009), as shown by overlaps between potential mining areas and conservation priorities. Overlaps between mineral resource-rich areas and high biodiversity conservation priorities highlight potential resource use conflicts. Areas that are high in both mineral and biodiversity conservation values need the most immediate attention. Areas with high conservation value but have relatively low mineral value may be recommended for inclusion in the NIPAS, in which resource valuation may be done as part of the NIPAS evaluation process. This partly answers the need to address gaps of the protected area system. It does not necessarily mean, however, that an area can be opened to mining if it has low or no significant conservation value. Factors such as social acceptability, environmental impacts, and indicators identified by Miranda *et al*. (2003) should equally be considered in view of proper land use planning.

The lack of a land use framework at the national level, which adopts an integrated ecosystem planning and management approach, compounded by weaknesses at the local land use and development planning, has given rise to resource use conflicts as other land uses come into play. The MEA sought to call attention to the consequences of decisions affecting ecosystems. The results help point the direction towards a revised way of planning and decision-making that looks beyond extractive values of natural resources and attaches appropriate recognition to other ecosystem services.

2. Recognition of gaps and challenges in the protected areas system

The protected areas system covers approximately 4.5 million hectares or 15% of total Philippine land area. However, it is still deficient in terms of the international minimum target set by the CBD. The Convention's Seventh Conference of the Parties held in 2003 set a target that at least 10% of each of the world's ecological regions (or ecoregions) should be effectively conserved (SCBD 2003). These ecoregions, developed by Olson *et al.* (2001), provide a framework for conserving biodiversity at a global scale by identifying representative habitats and species assemblages. In the Philippines, 12 ecoregions were identified, but the protected areas system falls short of the 10% target (MacKinnon in Ong 2002).

In the 4th National Report to the CBD submitted by Philippine Government through the Protected Areas and Wildlife Bureau (PAWB) of the DENR, it was reported that the proportion of terrestrial protected areas to total country land area increased from 8.5% in 1992 to 13.8% in 2008; thereby translating to increased protection of biological diversity and significant progress towards achieving the 2010 Biodiversity Target under the CBD. It is argued, however, that the management effectiveness of these protected areas are questionable. The formal designation of protected area status is not in itself sufficient to ensure conservation of the biodiversity contained within it.

Originally, protected areas undergo the 13-step NIPAS process towards their full establishment, a process that culminates in congressional action or the enactment of a site-specific law, followed by the actual demarcation of the protected area boundaries. The congressional action prescribes the actual extent and limits of the protected area. Of the 244 NIPAS components, only 10 have completed the process of establishment by congressional action. Although the DENR issued Administrative Order 2008-06 or the Revised Implementing Rules and Regulations of the NIPAS Act, which shortened the process in establishing protected areas from 13 to 10 steps, the full establishment of protected areas in the Philippines still proceeds in a slow pace, which has implications to biodiversity-rich areas still awaiting full NIPAS establishment (e.g., the extent can still be reduced as other land uses are considered, or as government priorities change).

MacKinnon (2002), in a preliminary analysis, revealed gaps and weaknesses in the Philippine protected areas system. NIPAS components are poorly related to the distribution of biodiversity throughout the country. Some protected areas have been established due to their historical or national significance but have little conservation value. Ong *et al*. (2002) identified 112 protected areas falling outside conservation priorities, and asserts that their suitability and distinction as NIPAS components need to be evaluated. DENR analysis similarly showed that only 51% of identified conservation priorities under the PBCPP were covered by the NIPAS. In other words, protected areas cover less than half of the priority biodiversity sites identified through scientific studies, and there are many protected areas that are not considered strategic for biodiversity conservation (PAWB 2009).

The analysis further showed that most protected areas contain a high proportion of degraded and converted habitats. Some protected areas have little relation to forest extents such that not all portions of contiguous forests are within the confines of protected area boundaries. The protected areas system is also biased on high elevation habitats, such as mossy forests; thus, providing poor coverage for lowland forests. Protecting these higher elevation habitats is essential because they exhibit the highest levels of unique species, owing to a variety of ecological factors like rainfall, humidity, and temperature. However, the lower elevations host the greatest species diversity. Generally, species richness tends to decrease as the elevation gradient increases, with the highest richness observed at mid-elevation ranges as pointed out by recent studies, particularly on small mammals and some groups of frogs (e.g. McCain 2005, Heaney *et al*. 2005, Diesmos *et al*. 2005). In birds, for example, 83% of the Philippines' threatened species occur in lowland forests (Collar *et al*. 1999). The bias towards protection of higher elevation habitats inadvertently marginalizes rich biodiversity occurring in the lowlands.

3. Areas closed to mining are insufficient

Significant conflicts exist and are well known between high biodiversity and mineral resource areas. One concern that confronts biologically rich areas is if these areas are closed and sufficiently safeguarded against mining. In Mindoro, seven protected areas under the NIPAS have been established. These protected areas cover the island's major ecosystems including forests, grasslands, freshwater lakes, mangroves, and coastal and marine habitats. But this begs the question concerning how effective is the management of these protected areas. Most of the existing protected areas in Mindoro also exhibit gaps and weaknesses. For example, F.B. Harrison, a bird sanctuary and game refuge established during the American colonial period, contain a high proportion of degraded and converted habitats, which has already been recommended for delisting. Mt Kadangyasan Forest Reserve covers mostly the forests of Mt Halcon, but leaves vast forest areas in San Teodoro, Puerto Galera, and Abra de Ilog unprotected. Forests that were identified as important conservation areas such as Mt Siburan and Lubang Island are not within NIPAS instruments. The shortcomings of the protected areas system unfortunately open avenues for extractive and highly destructive industries such as mining to access areas of high conservation value that deserve protection. An assumption that there are already enough areas closed to mining, therefore, is also misleading and does not sufficiently address the real conservation needs and characteristics of the country's biodiversity.

The 1995 Mining Act also explicitly identified areas that are closed to mining applications. These include military reservations, infrastructure areas, archeological and historic sites, and conservation areas, among others. Conservation areas closed to mining include: old growth or virgin forests, proclaimed watershed forest reserves, wilderness areas, mangrove forests, mossy forests, national parks, municipal and provincial forests, parks, greenbelts, game refuge / bird sanctuaries as defined by law, and in areas expressly prohibited under the NIPAS Act. The roster seemingly shows that important conservation areas have been adequately safeguarded, but these identified areas are not at all extensive or sufficient—an intrinsic limitation in the Mining Act provision that is not evident at first glance.

Remaining old growth or undisturbed forests is also debated as no longer existent due to massive logging activities in the past. Mossy forests found in high elevations could be considered as the only forests left undisturbed since their apparent inaccessibility afforded them some degree of protection, and possibly it continues to stay that way until this time. Lowland forests are left mostly unprotected and subject to various land use activities. These lowland forests, while constituting the greater portion of total remaining forest cover and exhibiting the highest levels of biodiversity in terms of species richness, still extensively have no protection under the NIPAS Act.

4. Potential exacerbation of disaster risks by mining

While data on the full social and economic impacts of disasters across many areas in the Philippines is incomplete, the existing data clearly indicates that these events have had a grave impact on the development of the country over the past decades. Moreover, current trends such as urbanization, environmental degradation, and climate change will bring even more severe impacts. Poverty and disaster vulnerability are inextricably linked, and efforts to reduce poverty will simply not be sustainable without addressing disaster risk reduction.

In Mindoro, mining may not contribute directly to the occurrence of natural hazards, but it potentially exacerbates the impacts of these hazards as well as the vulnerabilities of communities, thereby increasing disaster risks and climate variability impacts. Where Mindoro is situated, for example, the trend of more frequent typhoon crossings which have been projected across the Visayas or central Philippines (Villarin *et al*. 2008) may affect its landscape increasing the incidence of flooding, landslides, and soil subsidence; or effect changes in the micro-climate, thereby affecting agricultural production, and even the wildlife populations and their habitats. Mindoro, being environmentally and socially sensitive, can be adversely and severely affected by mining failures, the impacts of which could be very costly to ecosystems and to communities who depend upon them for their survival.

A more comprehensive risk analysis is necessary to effectively determine the potential impacts of disaster events in the Philippines, and even more at local scales due to the variability of climate change impacts across different parts of the archipelago. Undertaking such an analysis will allow more informed decisions to be taken in terms of priority actions and investments to reduce these potential impacts and ensure the social and economic growth of the country in years to come.

5. Economic valuation of resources is necessary

A useful tool towards establishing a rational land use regulation is the resource valuation method. The resource valuation approach can be a valuable tool that would enable decision-makers to adequately weigh all available resources in light of multiple or competing land-uses. However, the approach can only be effective if it is used to provide a basis for reaching informed decisions on the most appropriate, if not the best, land use options. The conflicts existing between mineral- and biodiversity-rich areas and the critical state of the country's ecosystems make valuation necessary. The obvious conflict or overlap between competing resource uses clearly states that, at the onset, prudent and cautious steps need to be undertaken prior to opening any area for mining. The decision by national government to take on an active role in the outright promotion of mining in the country is definitely misguided in light of the existing overlaps alone, not even considering mining's negative impacts to the environment and local communities in the past.

A reassessment of potential mining areas using resource valuation methods would have to be undertaken, taking into consideration conservation value and mineral value of these areas. Areas that are high in both mineral and biodiversity conservation values need the most immediate attention. EO 270 and the Mineral Action Plan provide for the identification of a "rational and science-based valuation tool to determine the best and alternative uses of the areas including high biodiversity and conservation/protection areas." However, no such tool has yet been created while priority mining projects have already been identified and pursued. There is already a policy decision that developing the mining industry is a national strategy for economic development, given the richness of the country's mineral resources. The presence of minerals then becomes the primary deciding factor.

The Mineral Action Plan states that one of its strategies is to "incorporate biodiversity and small island ecosystem concerns in the EIA process for mining projects in biodiversity-rich areas and small islands." But biodiversity then becomes just one of the concerns to be addressed for which safeguards must be created, rather than a primary consideration for a decision *not* to mine certain areas.

While valuation may not be expected to be a panacea for the ills plaguing the mining industry, it provides a valuable tool for decision-making and planning, especially in highly competing resource use areas. It is important to note, however, that valuation must be pursued through a process that involves the local communities and governments who are the direct stakeholders of the natural resources. Beyond merely being an academic or economic exercise, valuation should be a tool that enables local empowerment, providing people with a comprehensive appreciation of their resources and giving them a voice as to how those resources will be managed. It can help determine the value of natural resources, who benefits from them, and who will be affected by certain resource use changes. All of these information will point the way to identifying rational management and use options for the available resources.

This framework is a vast improvement from current national government approaches that seek to address local conflicts mainly through increased consultations and information dissemination on the benefits of mining. This approach carries a presumption that most local opposition is caused by lack of information on mining operations and benefits. However, lack of knowledge is not the only possible hindrance to obtaining local support; information dissemination activities, while also important, do not address the question of the suitability of having mining operations in a given area. Resource valuation can provide a solid basis for an informed and participatory decision-making.

6. Local planning and local empowerment

Considering the growing population of the country, wherein an estimated 33% of the 76.5 million total population in 2000 (roughly 25 million) reside in the uplands or near forests where prospective mineral operations are, every development pursuit should be compatible with and should involve the community. Mining is characterized by extensive influxes of foreign capital, large conversions of land that result in displacement of communities, highly mechanized operations that require lesser human labor, and environmental impacts that imperil local livelihoods or industries. Mines also have a limited life of operations of only a few decades, which even after rehabilitation measures could result in extensive changes or damages that the community may find hard to cope with.

These fears are quite valid, as the mining industry in the Philippines has had a spotty record in terms of environment, social and even economic performance. The problems of abandoned mines (Bacagay, Samar) and environmental damages (Marcopper tailings spill in Marinduque) have yet to be adequately rectified. Government has given assurances that rehabilitation of these areas will be prioritized, but at the same time, new mining projects are being developed. While these so-called "legacy mines" still remain, opening up of mining operations in the country will always be a contentious issue. Even environmental impacts of existing mines are not adequately addressed.

The biogeographical characteristics of the country, its growing population, the legacy mines—in the context of high poverty incidence, environmental degradation, and a myriad of natural hazards and looming climate change vulnerabilities—are just few of the factors that seriously call into question the aggressive promotion of the mining industry. Addressing these factors require a level of planning both at the national and local levels that may not be attained while the policy direction overwhelmingly favors minerals development.

This lack of proper planning gives rise to conflicts in resource use priorities, and indeed the revitalization program has already been met with considerable opposition from various groups and in its priority areas. A legal crisis may also well be in the offing, as some local governments assert their rights to autonomy, using Local Government Code provisions to issue mining moratoria over their jurisdictions. Local government units that have passed mining moratoria include Capiz (1999), Oriental Mindoro (2002), Iloilo, Samar (2003), and Eastern Samar (2003). Puerto Princesa City also issued a moratorium in July 2005 but repealed it two months later on the belief that it runs counter to national laws. Mindoro Occidental declared a mining moratorium in the province in late 2009. The validity of these existing mining moratoria in the face of the national policy promoting mining is being challenged in court. However, considering the lack of adequate planning at the national level, local planning and decision-making processes have the opportunity to fill the voids and should then take on more significance. As a matter of policy, the national government should be prepared to step back should local planning processes result in a decision to disallow or limit mining operations.

E. Conclusions

The discussions in the previous sections have shown the implications of the existing mining policy with respect to addressing Mindoro Island's—and that of the country's—characteristics as a high conservation value area with correspondingly high levels of degradation, poverty, disasters, vulnerabilities and risks.

Significant conflicts exist and are well known between high biodiversity and mineral resource areas. In the meantime, the revitalization of the mining industry continually pushes through, with new mine projects being opened up and government going on high-profile international sales pitches in an attempt to court more investments.

Failure to adequately evaluate these conflicting resource use priorities can spell disaster for biodiversity but also to long-term sustainable development. The mining industry is being pursued with the single-minded view of generating revenues without duly considering other critical factors, such as the value and services provided by the biodiversity and ecosystems that may be adversely impacted by mining operations.

Based on the analysis conducted in this study, the following conclusions can be put forward:

[1] The state of the country's ecosystems, including the case of Mindoro, are already critical and will not withstand further impacts from a revitalized mining industry. The development of the mining industry should be pursued, if it should be at all, in a limited and cautious manner in light of the findings presented above.

[2] Current policies relevant to the mining sector exhibit inherent weaknesses such that the country's conservation needs are not adequately addressed. Minerals development cannot proceed under an assumption that there are enough safeguards to the environment and community safety nets in the existing policies. A revision of the current policies that places environmental sustainability and public participation at the core is necessary, prior to pursuing a revitalized mineral development.

[3] The presence of competing resource use priorities stems from the lack of a comprehensive land use framework that adopts an integrated ecosystems approach, both at the national and local levels. Economic valuation methods of natural resources that involve local participation should be an integral part of land use planning to determine the most appropriate resource use options. An integrated ecosystems approach to land use planning in Mindoro—that which reflects the value of ecosystem services to human well-being—should be adopted with broad stakeholder involvement.

[4] The best development options for Mindoro, and that of the country, can only be identified upon the implementation of a comprehensive land use planning framework through economic valuation of resources that appreciates biodiversity and involves local stakeholders.

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Figure 1. Overlapping boundaries of potential mineral areas and biodiversity conservation priorities in the Philippines.

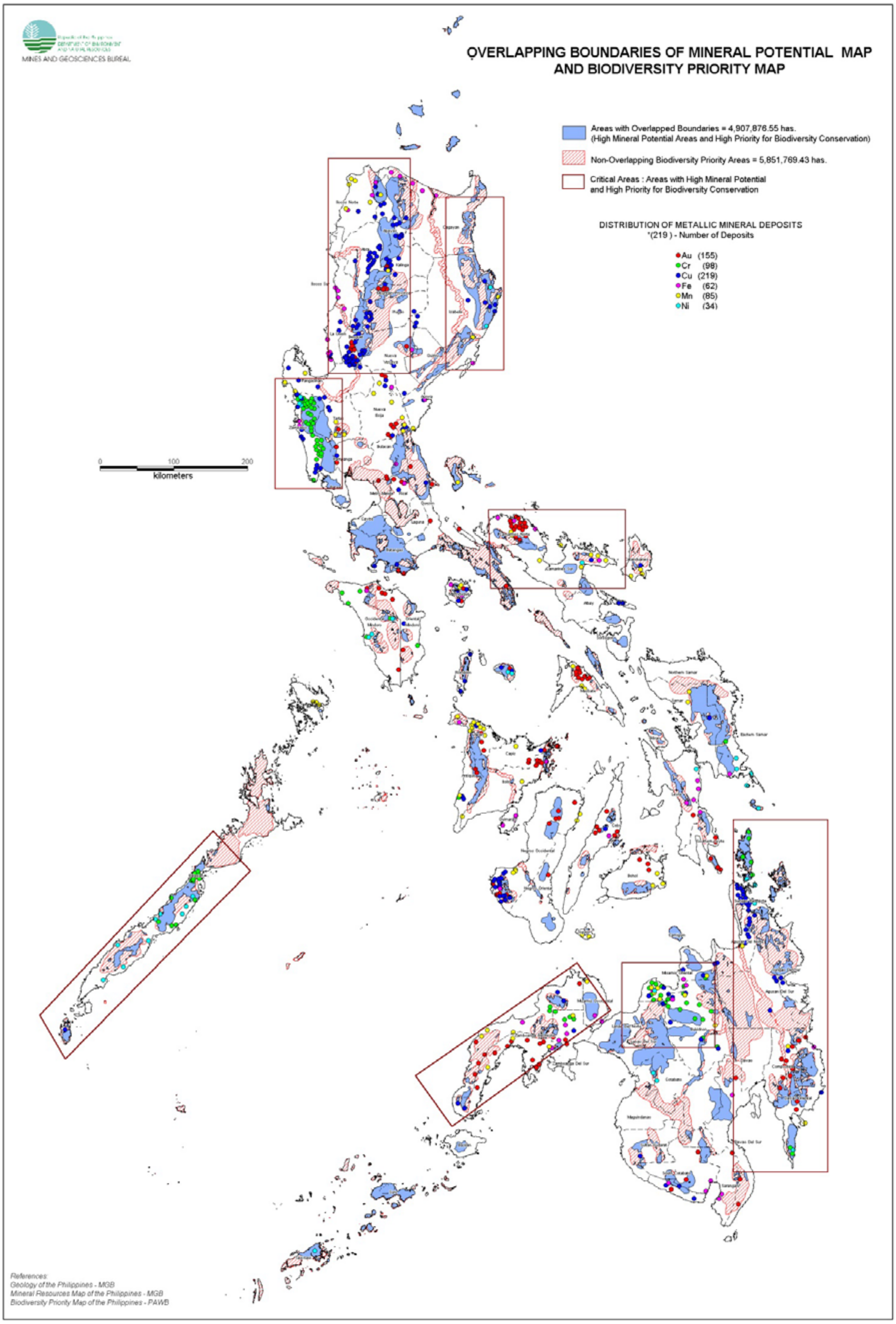


Figure 2. Mining tenements vis-à-vis major watersheds and forest cover in the Philippines.

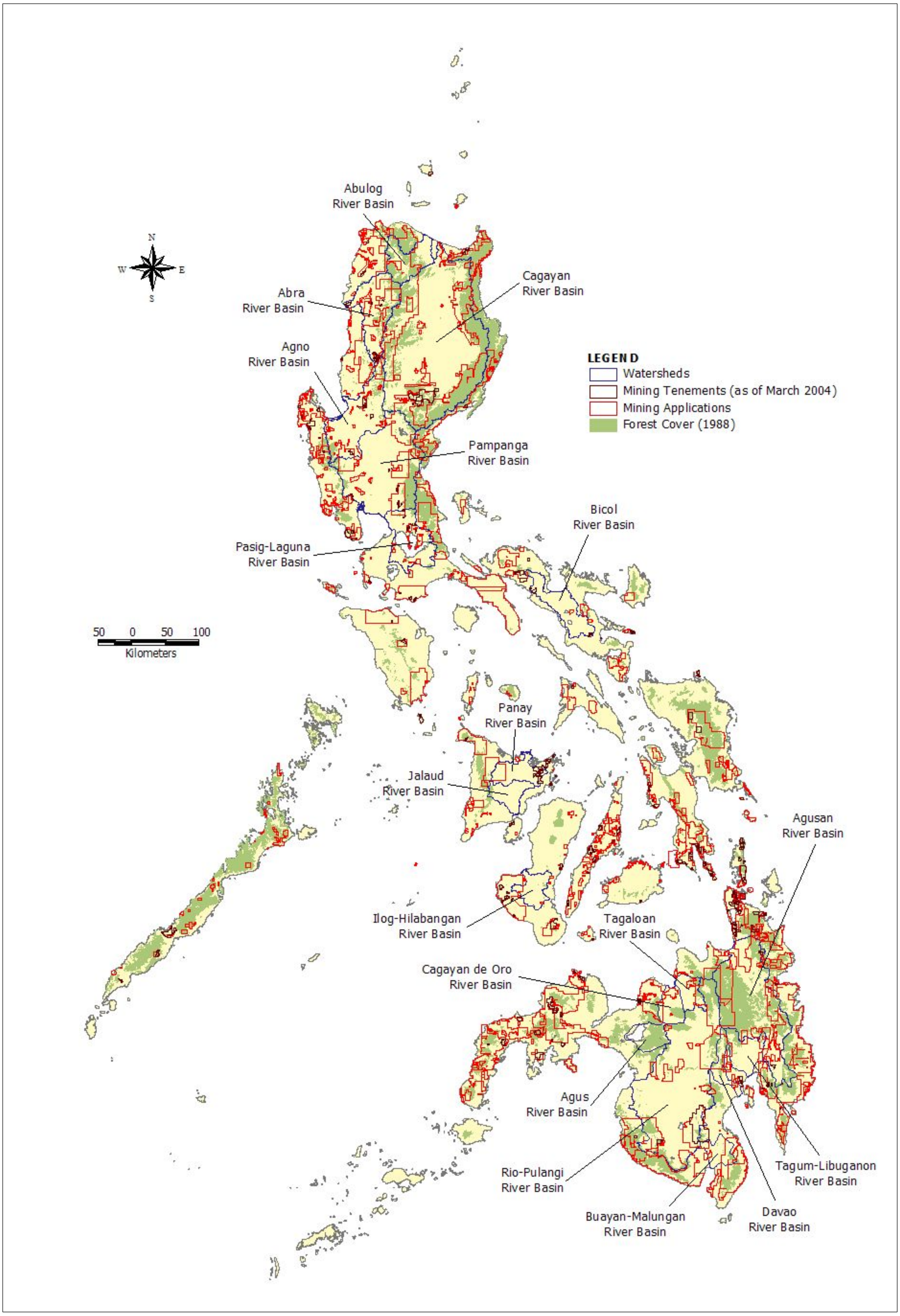


Figure 3. Climate map of Mindoro Island.

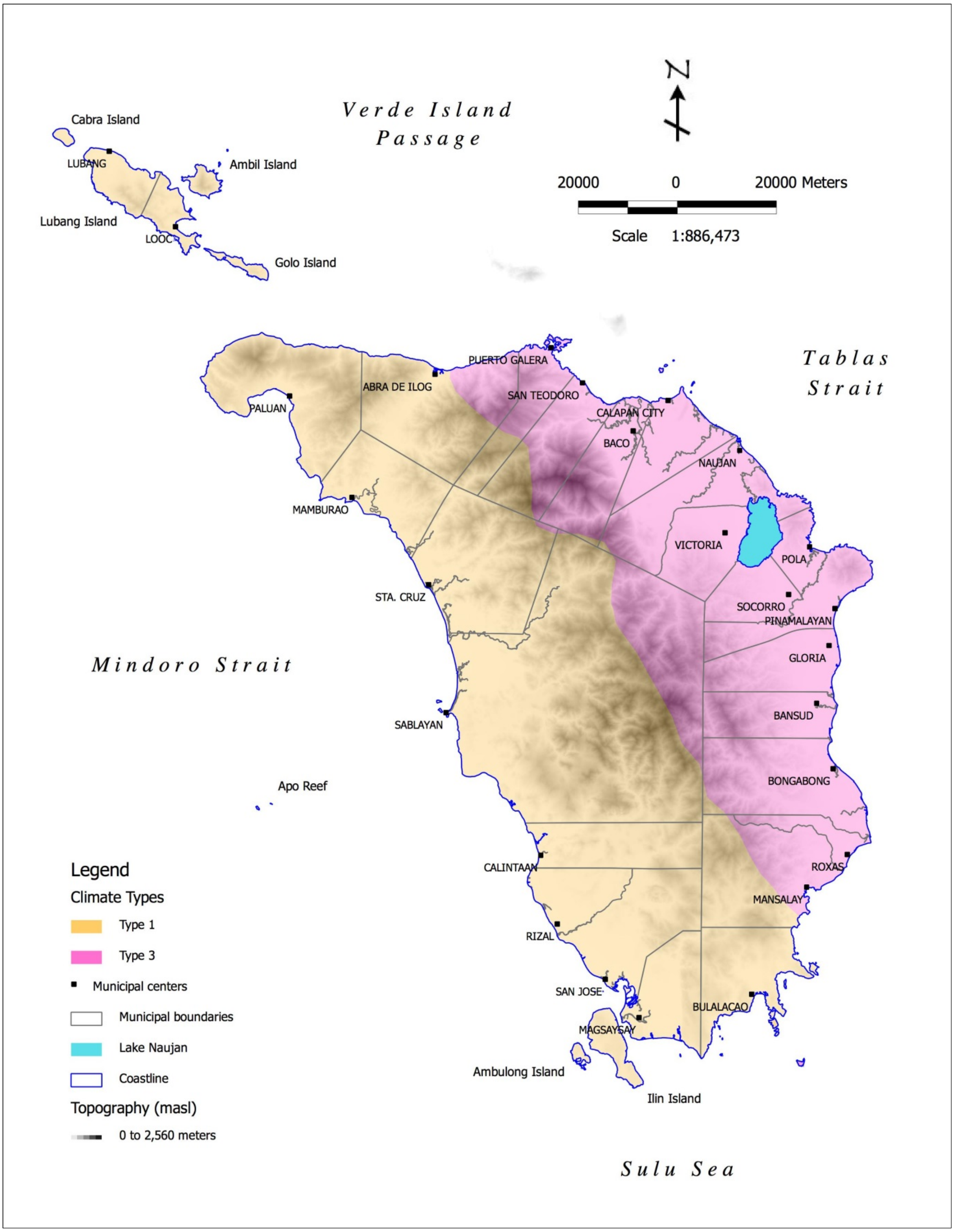


Figure 4. Land cover map c.2003 of Mindoro Island.

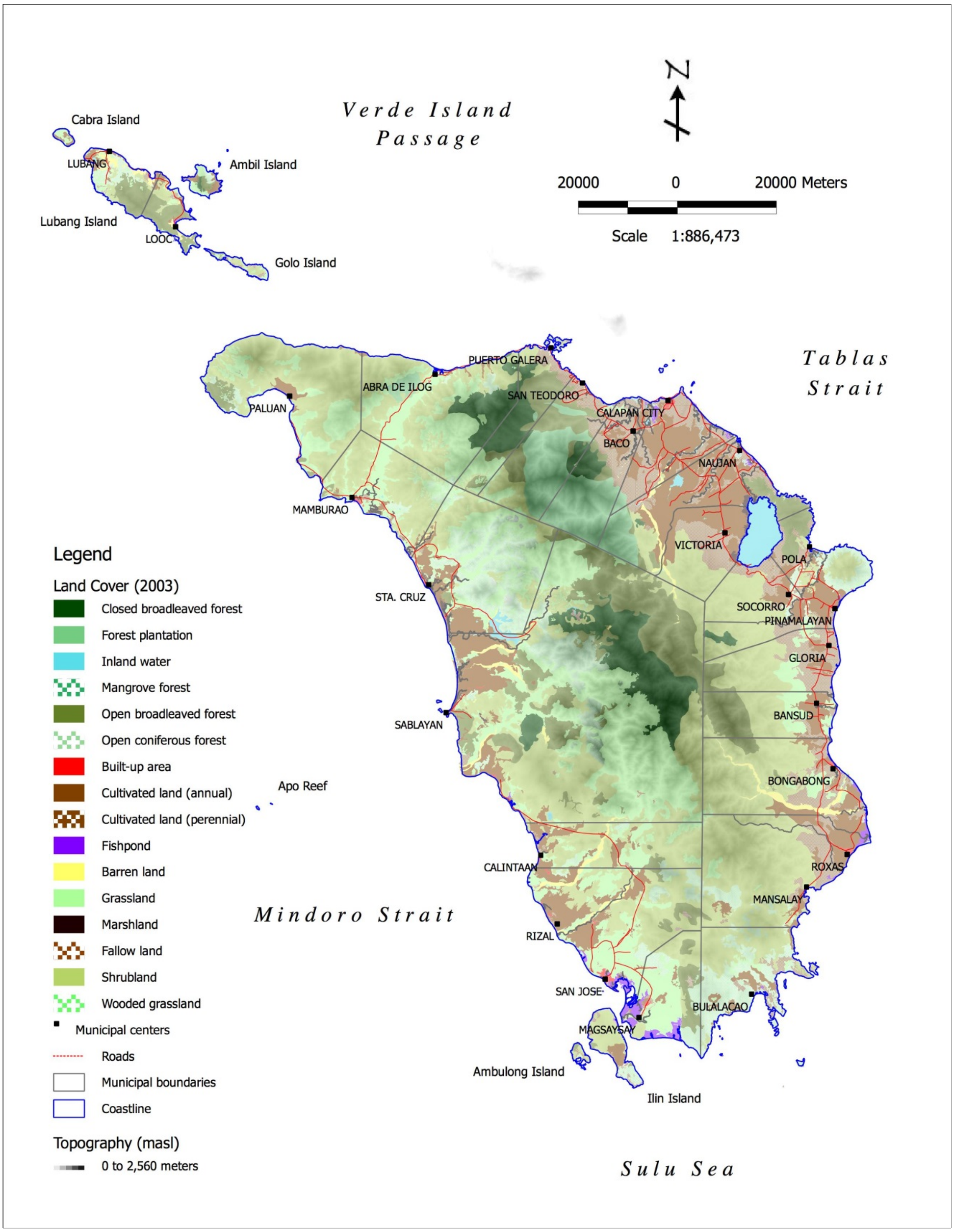


Figure 5. Prospective mineral resources found in Mindoro Island (adopted from BMG 1986).

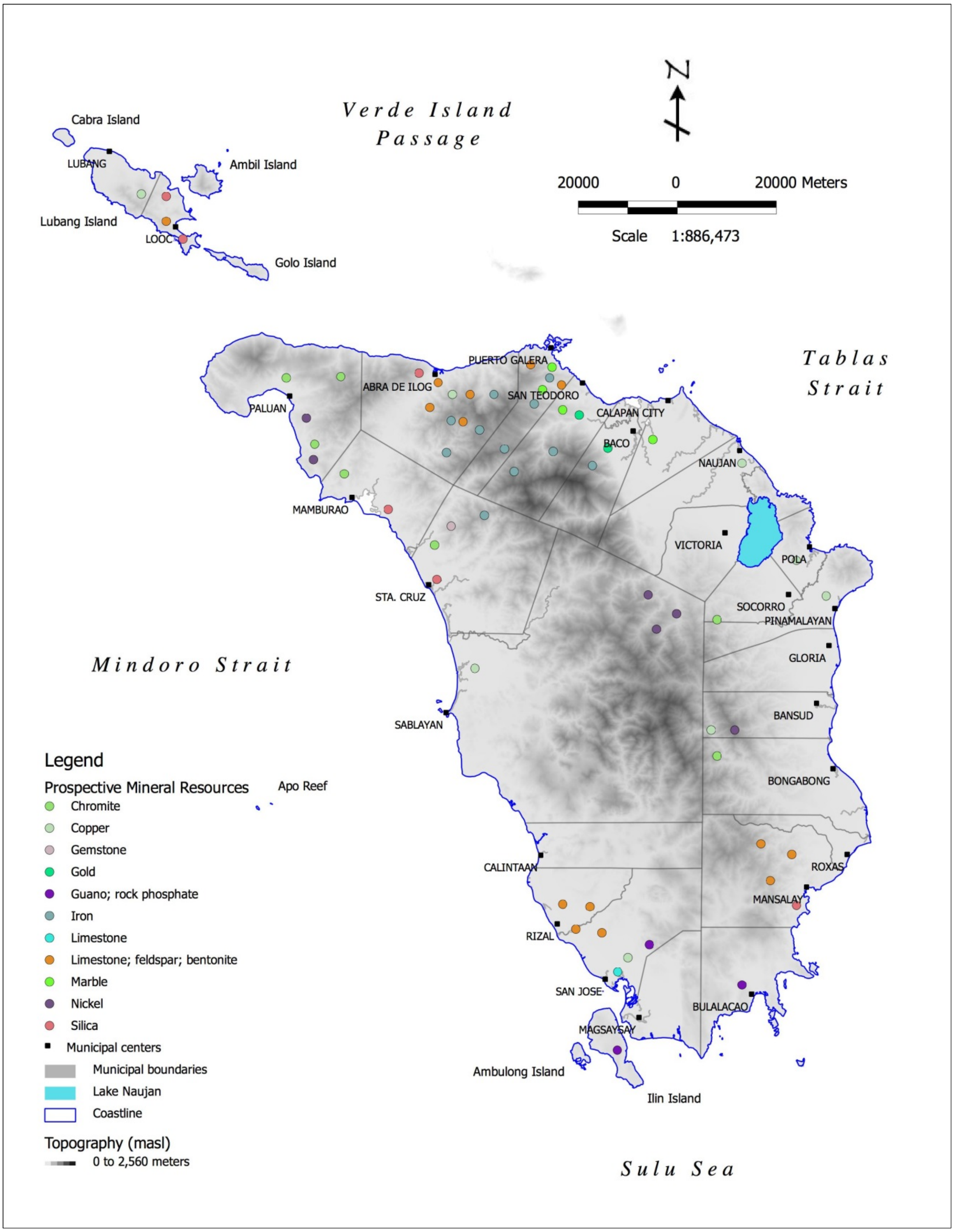


Figure 6. Major watersheds of Mindoro Island vis-à-vis administrative boundaries.

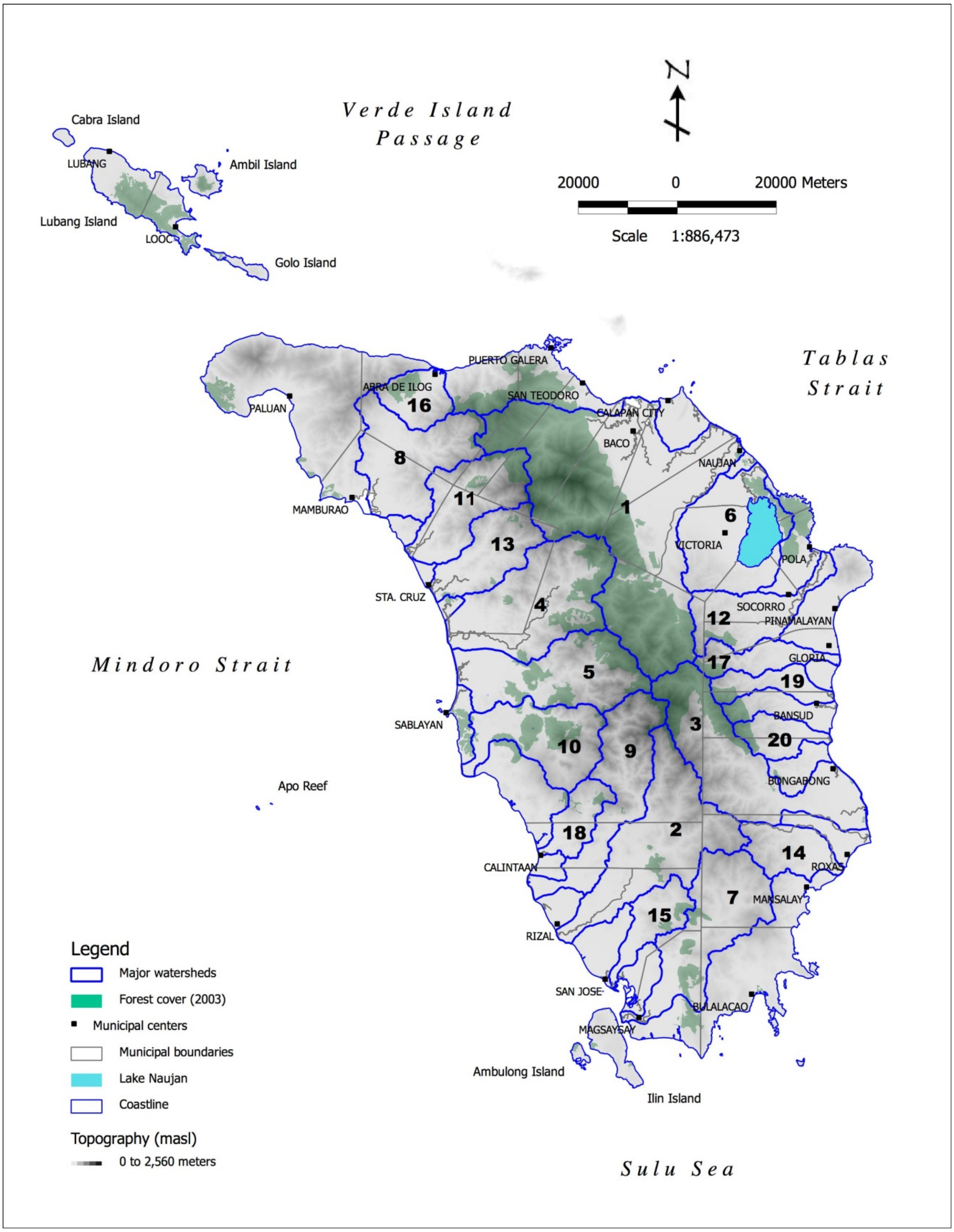


Figure 7. Percentage of forest cover within each major watershed of Mindoro Island.

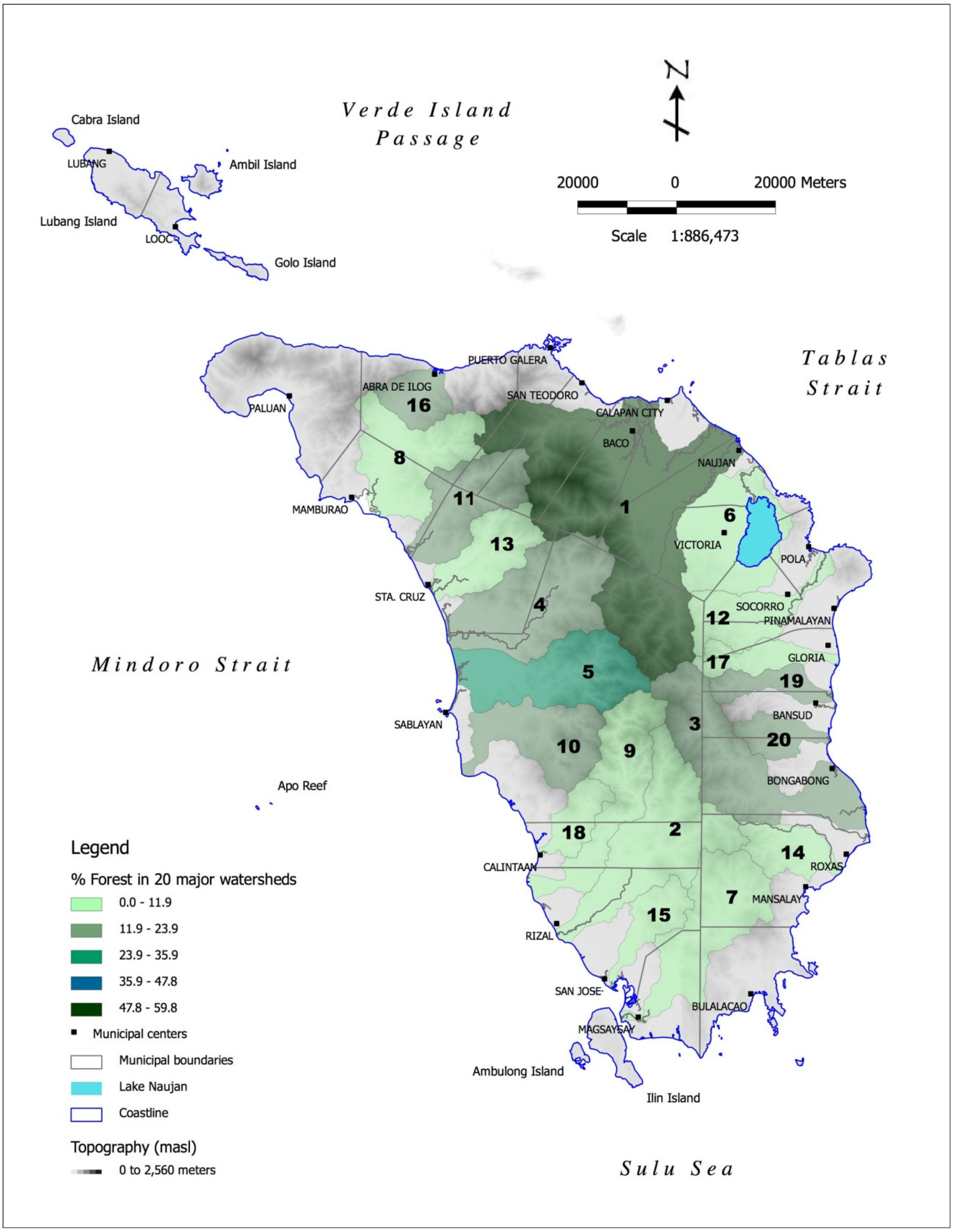


Figure 8. Tenurial instruments found on Mindoro Island.

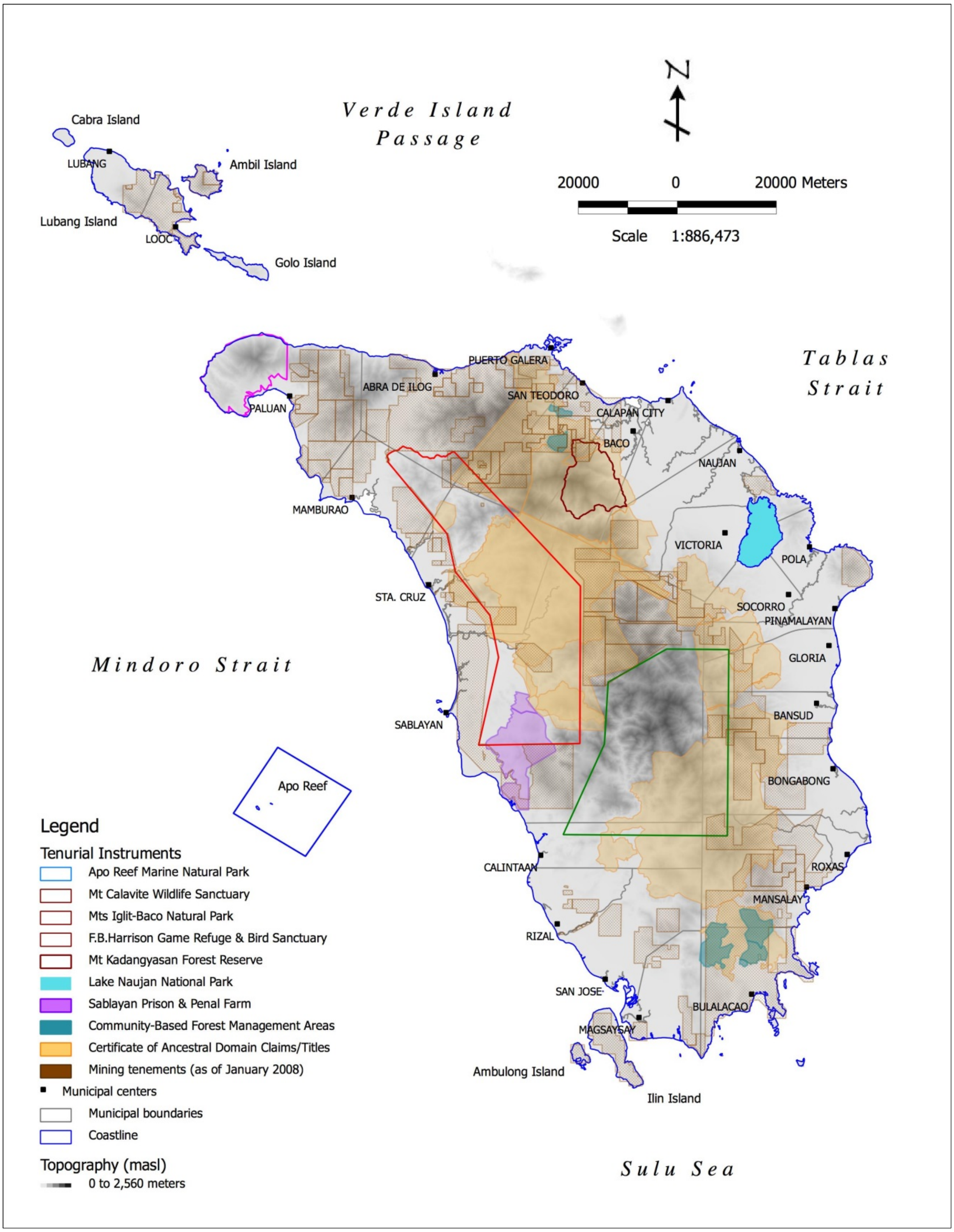


Figure 9. Conservation priority areas in Mindoro Island.

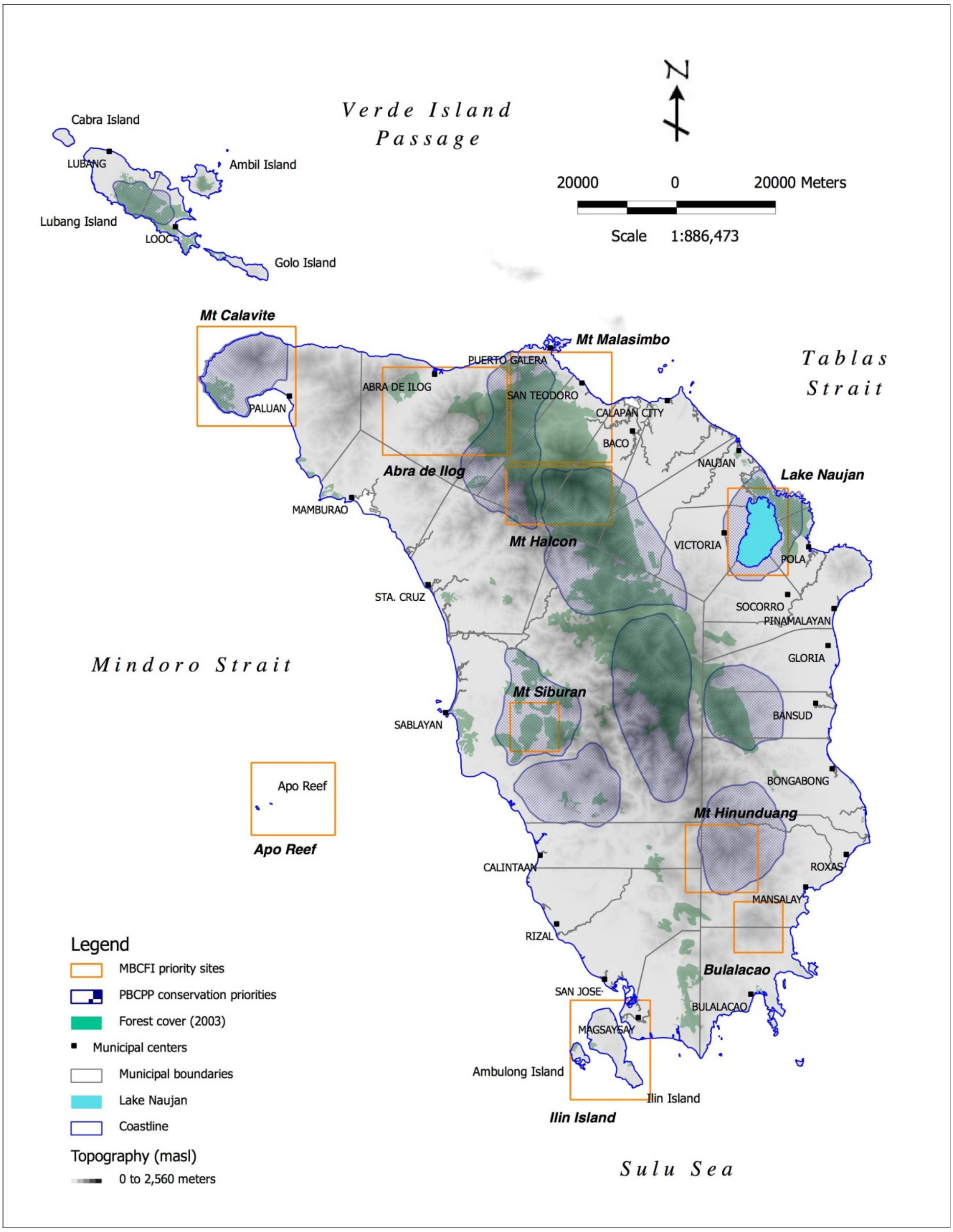


Figure 10. Overlapping boundaries of conservation priority areas and mining tenements on Mindoro Island.

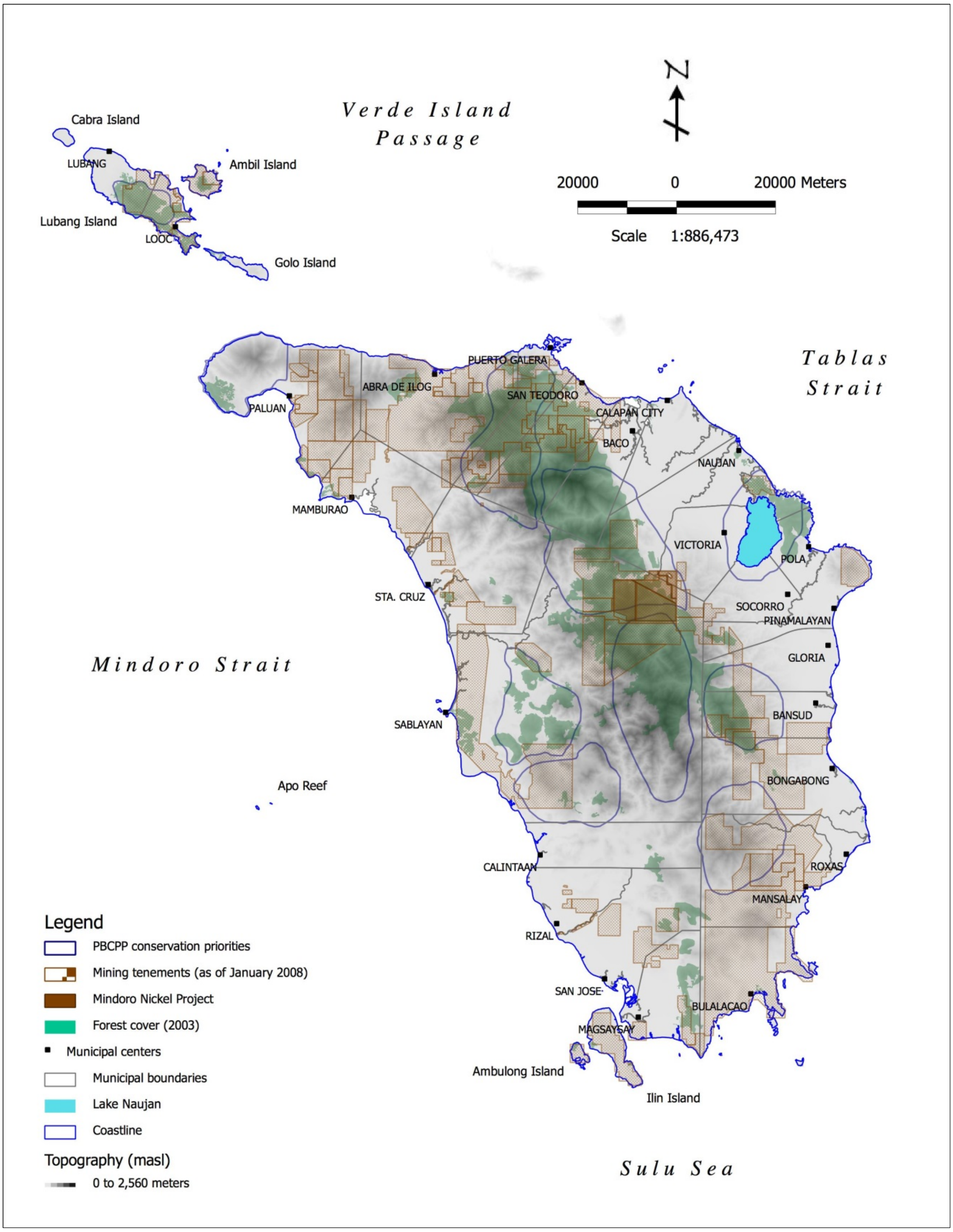


Figure 11. Major watersheds and forest areas affected by mining tenements on Mindoro Island.

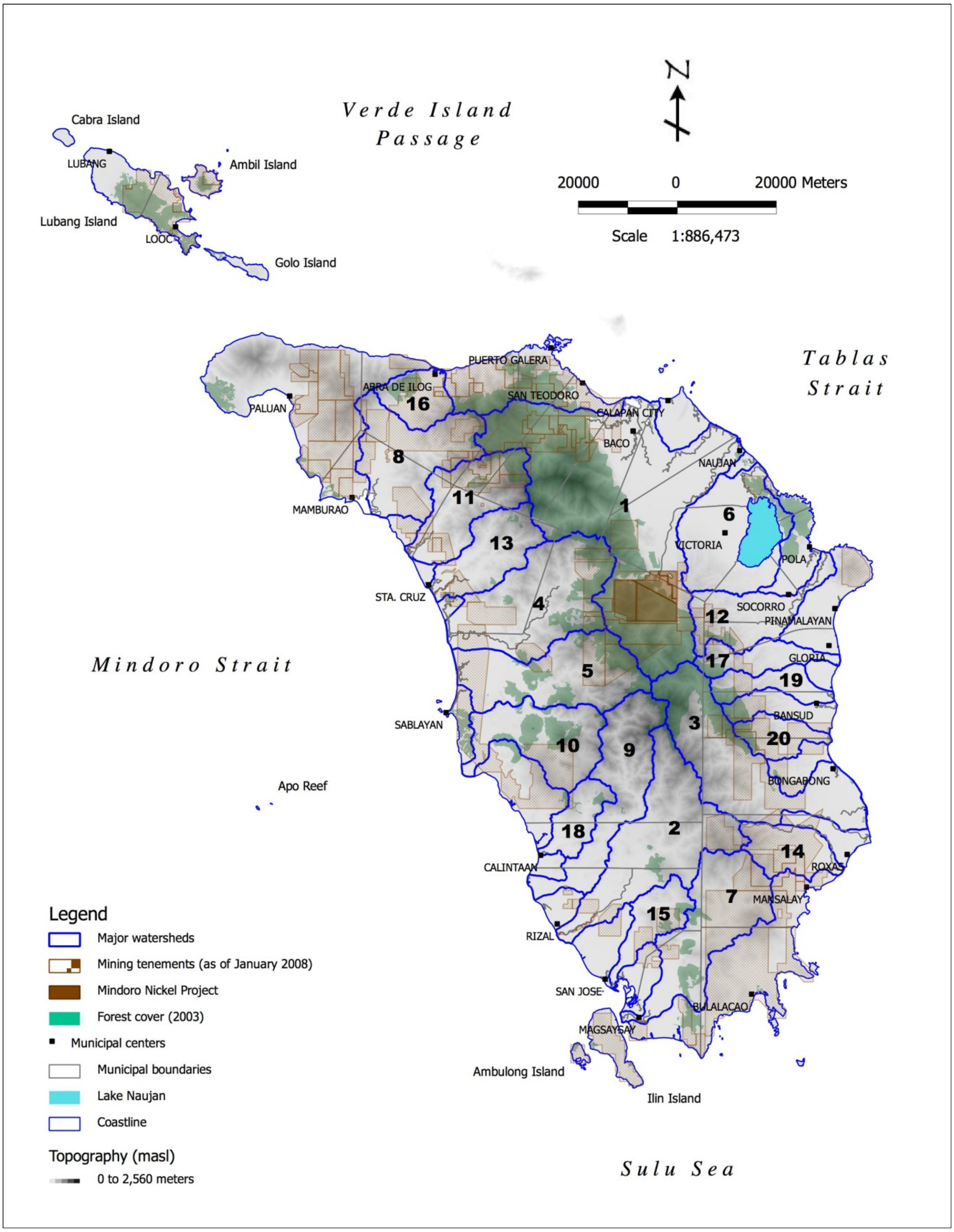


Figure 12. Major watersheds (showing % of remaining forests) affected by mining tenements on Mindoro Island.

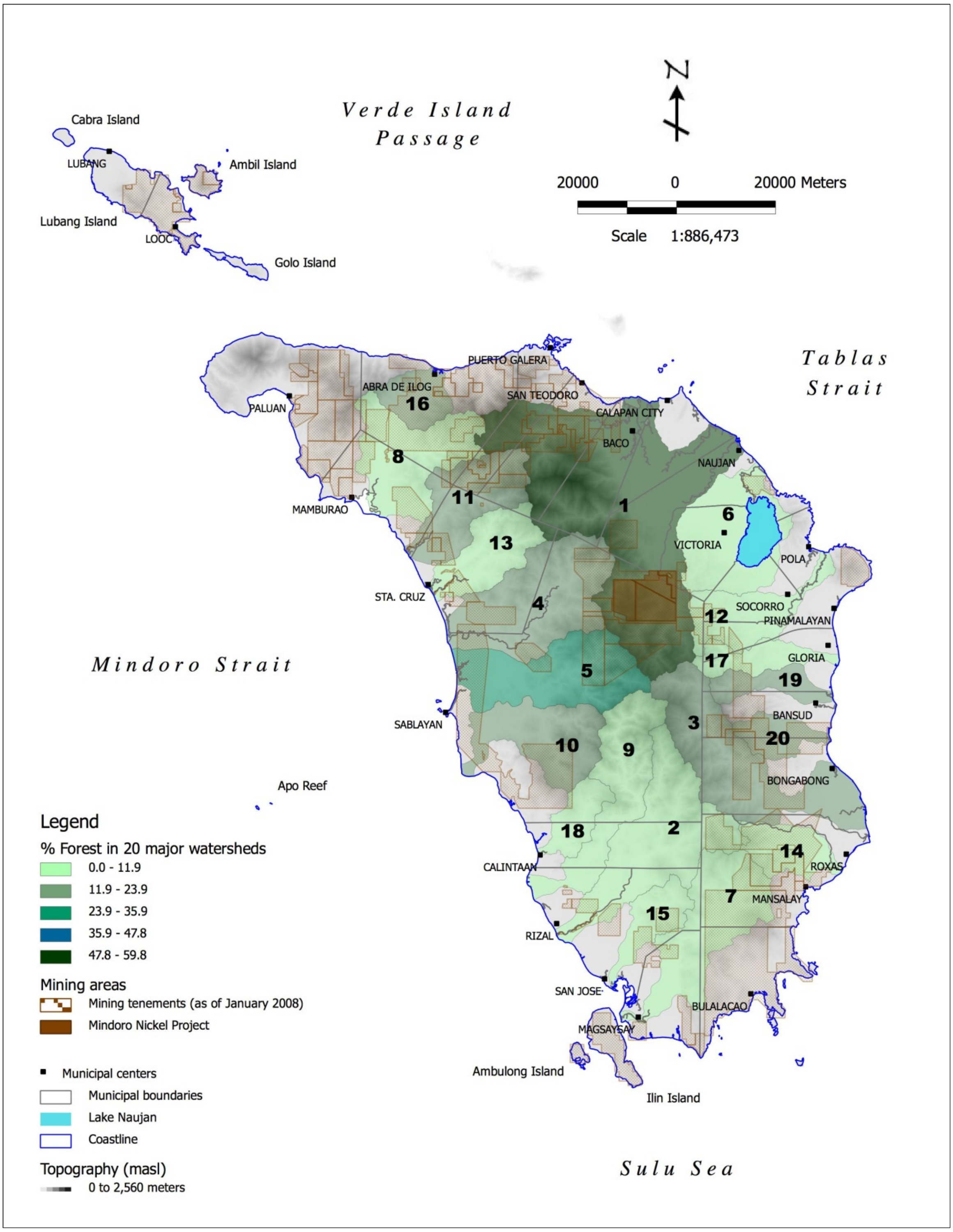


Figure 13. Total population in 2007 per municipality of Mindoro Island.

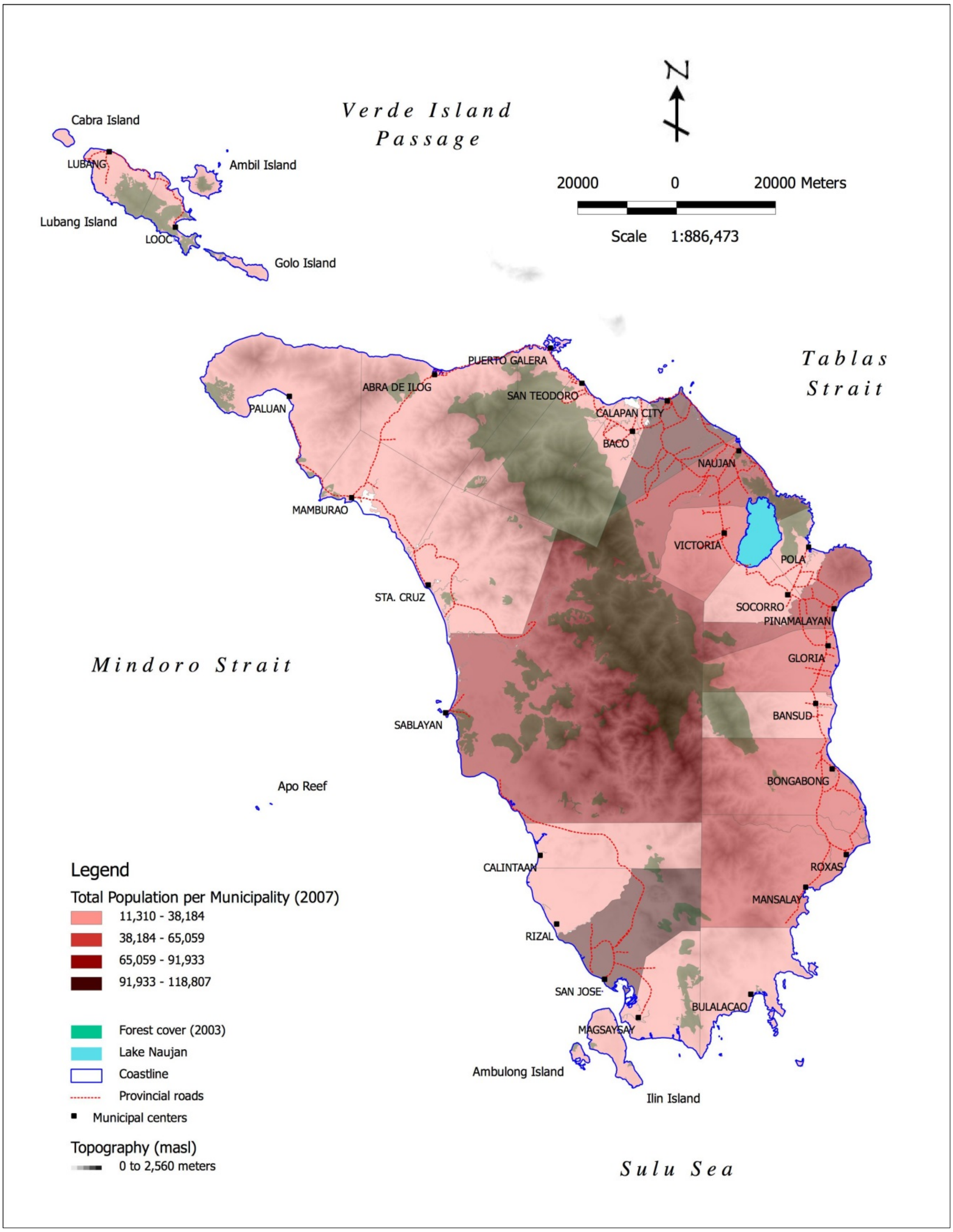


Figure 14. Population density in 2007 per municipality of Mindoro Island.

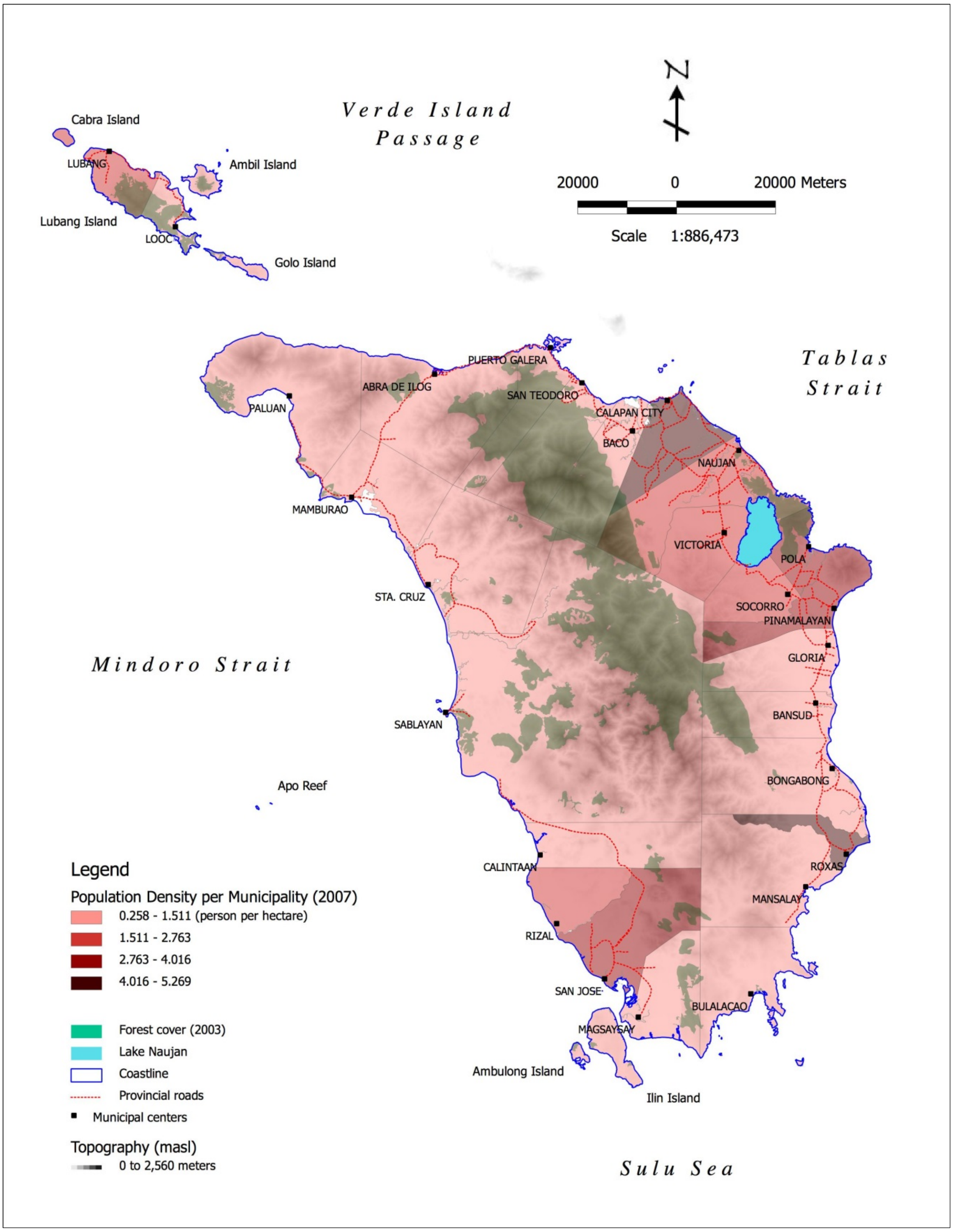


Figure 15. Population growth rate (2000 – 2007) per municipality of Mindoro Island.

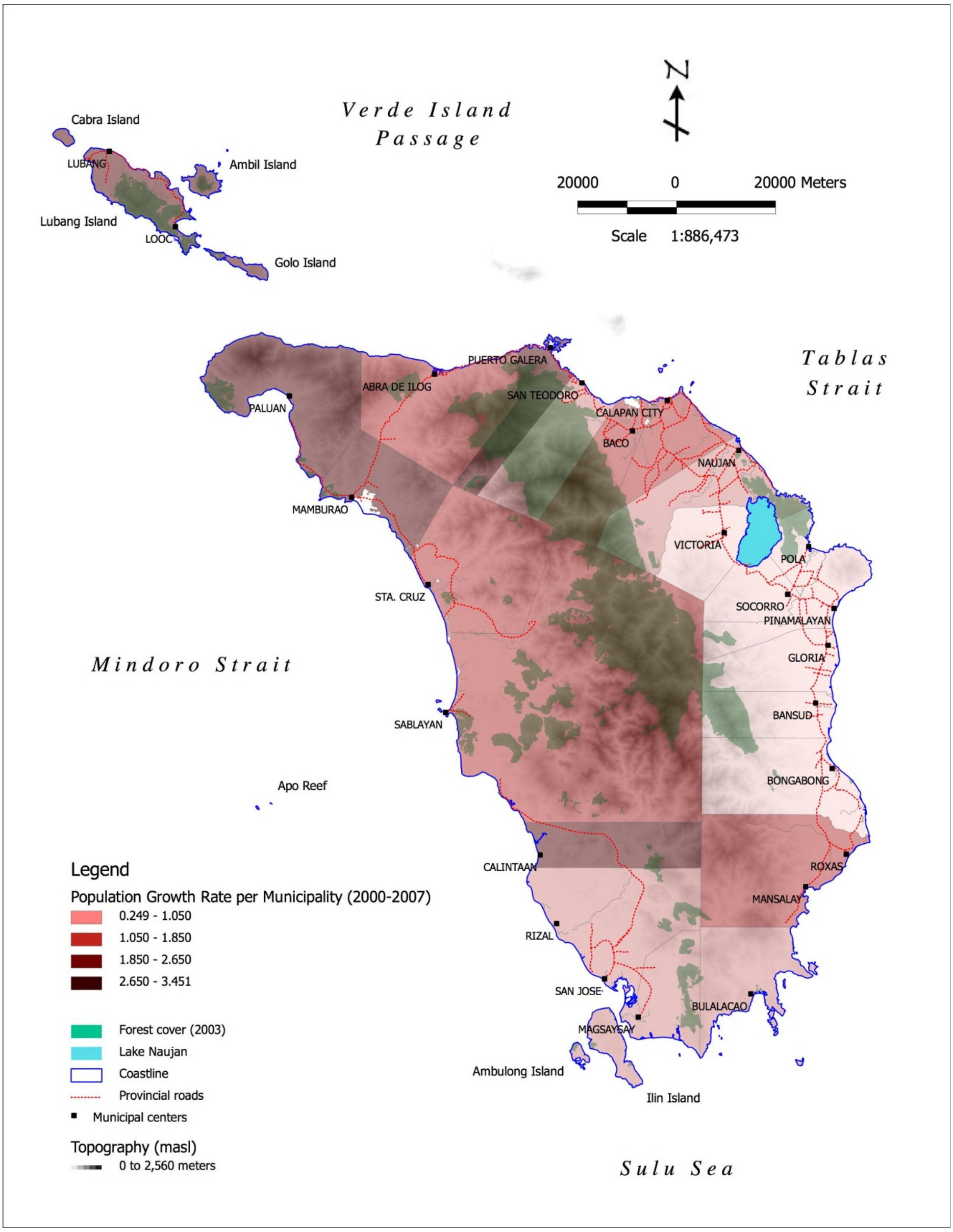


Figure 16. Potential population pressure per municipality of Mindoro Island.

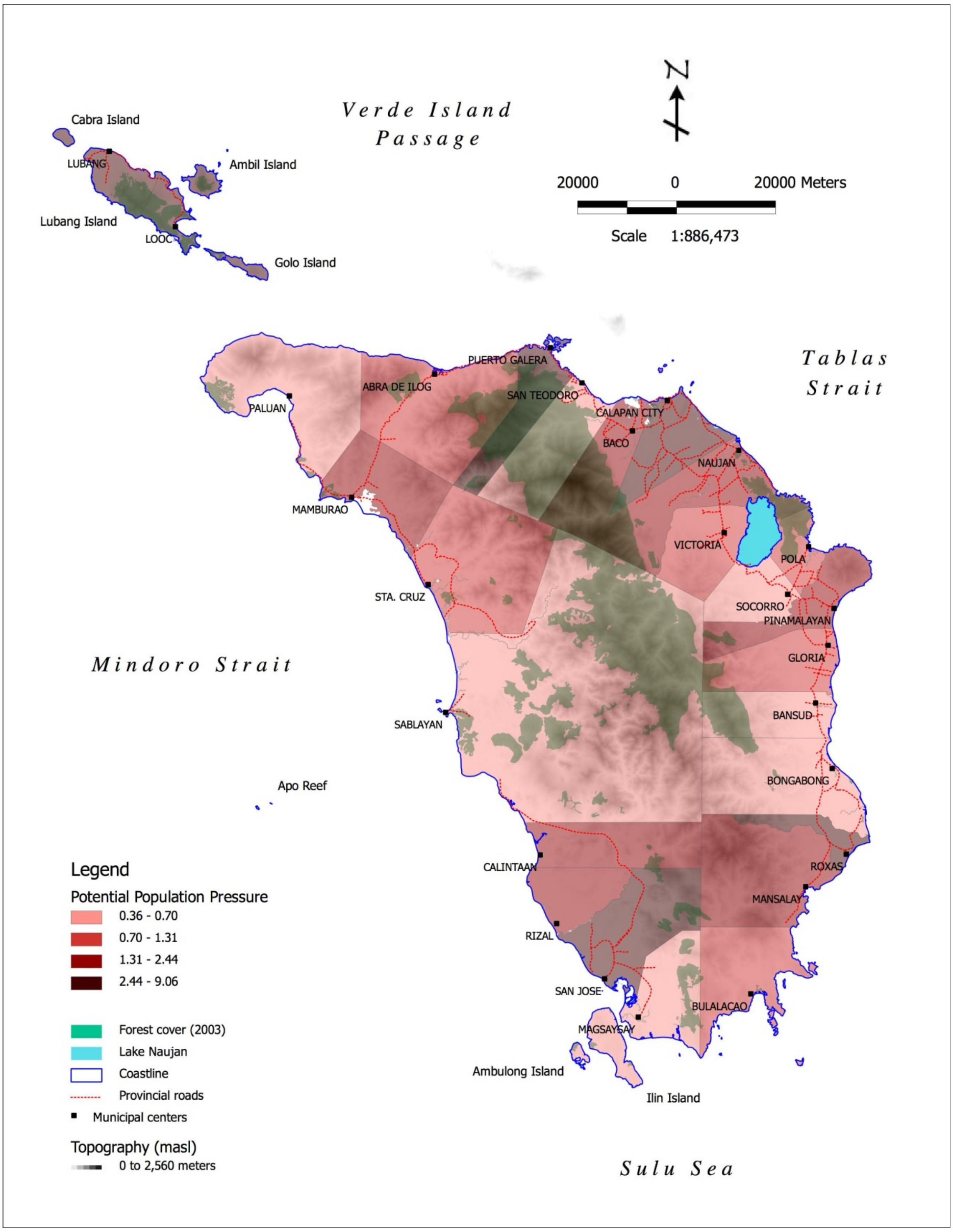


Figure 17. Overall poverty index results per municipality of Mindoro Island.

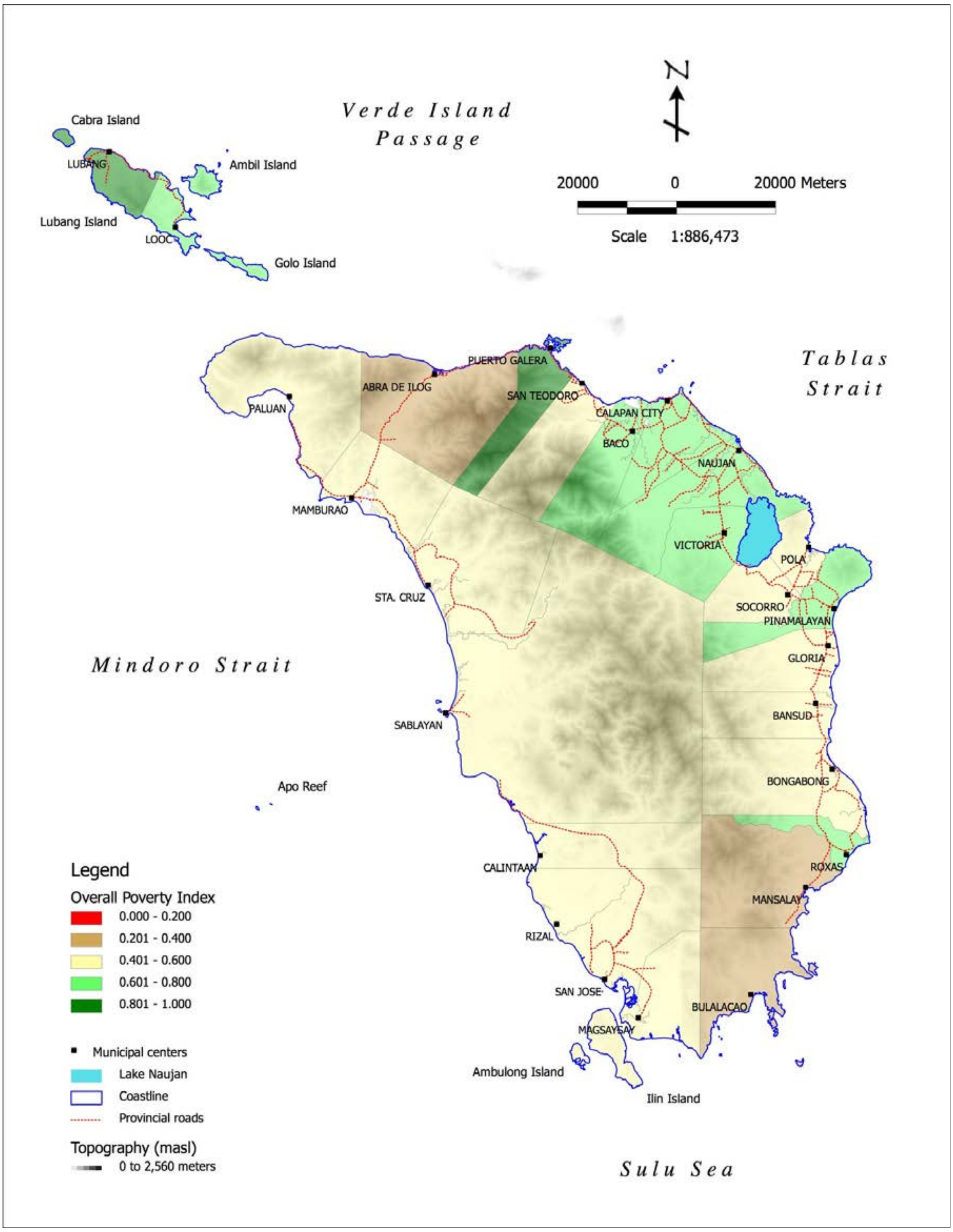


Figure 18. Conservation priority areas and the overall poverty index results per municipality of Mindoro Island.

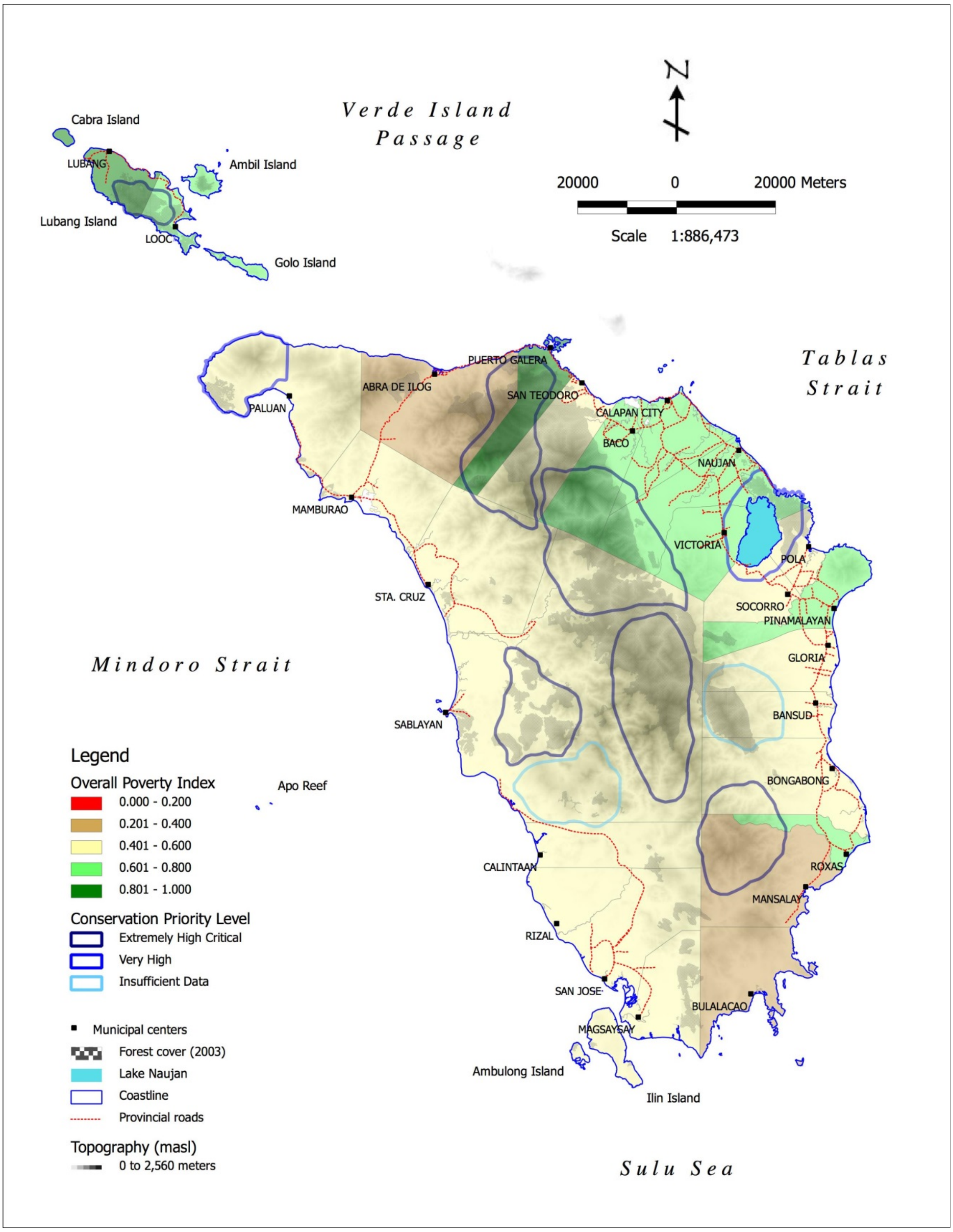


Figure 19. Households with strong roof materials index results per municipality of Mindoro Island.

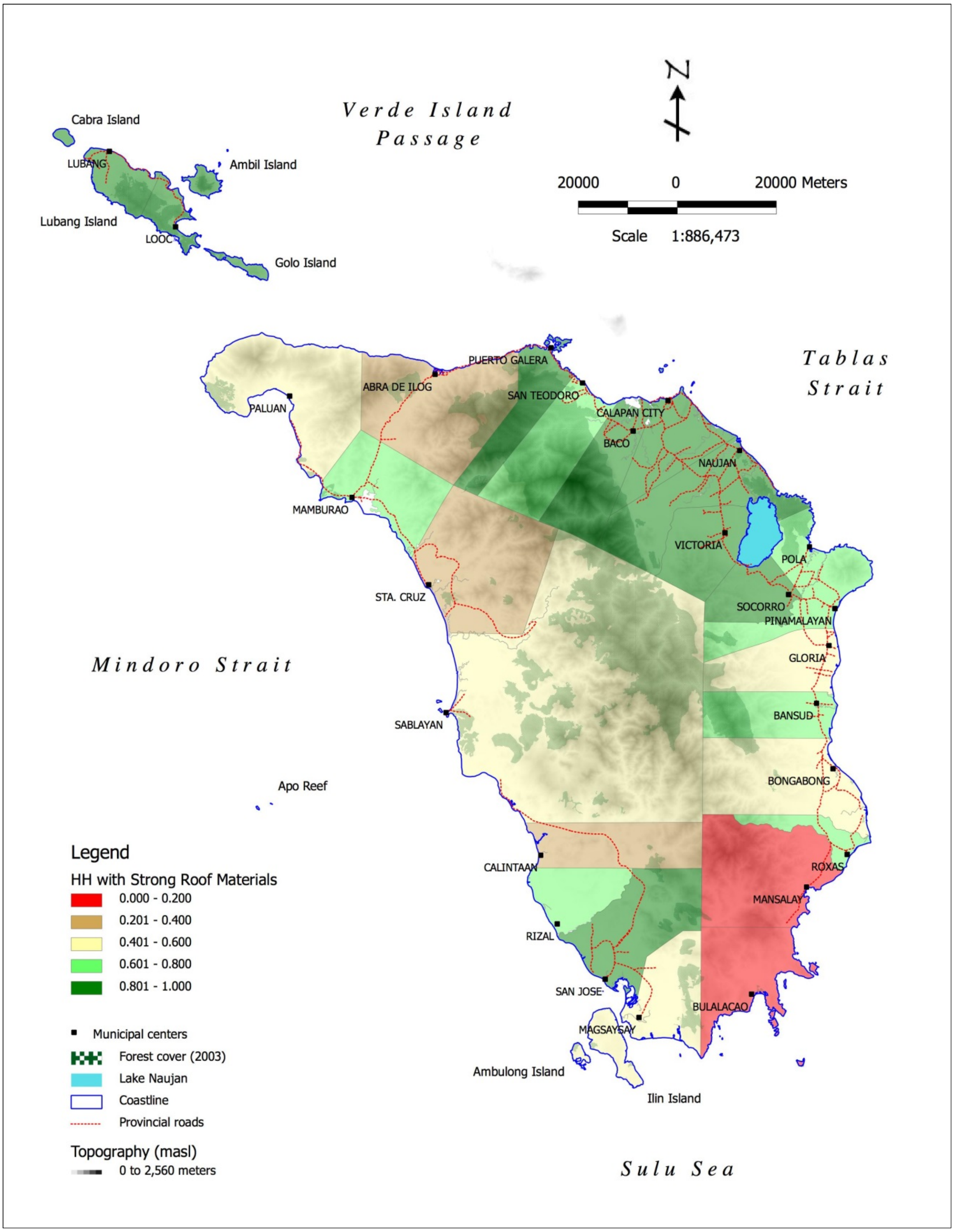


Figure 20. Households with strong wall materials index results per municipality of Mindoro Island.

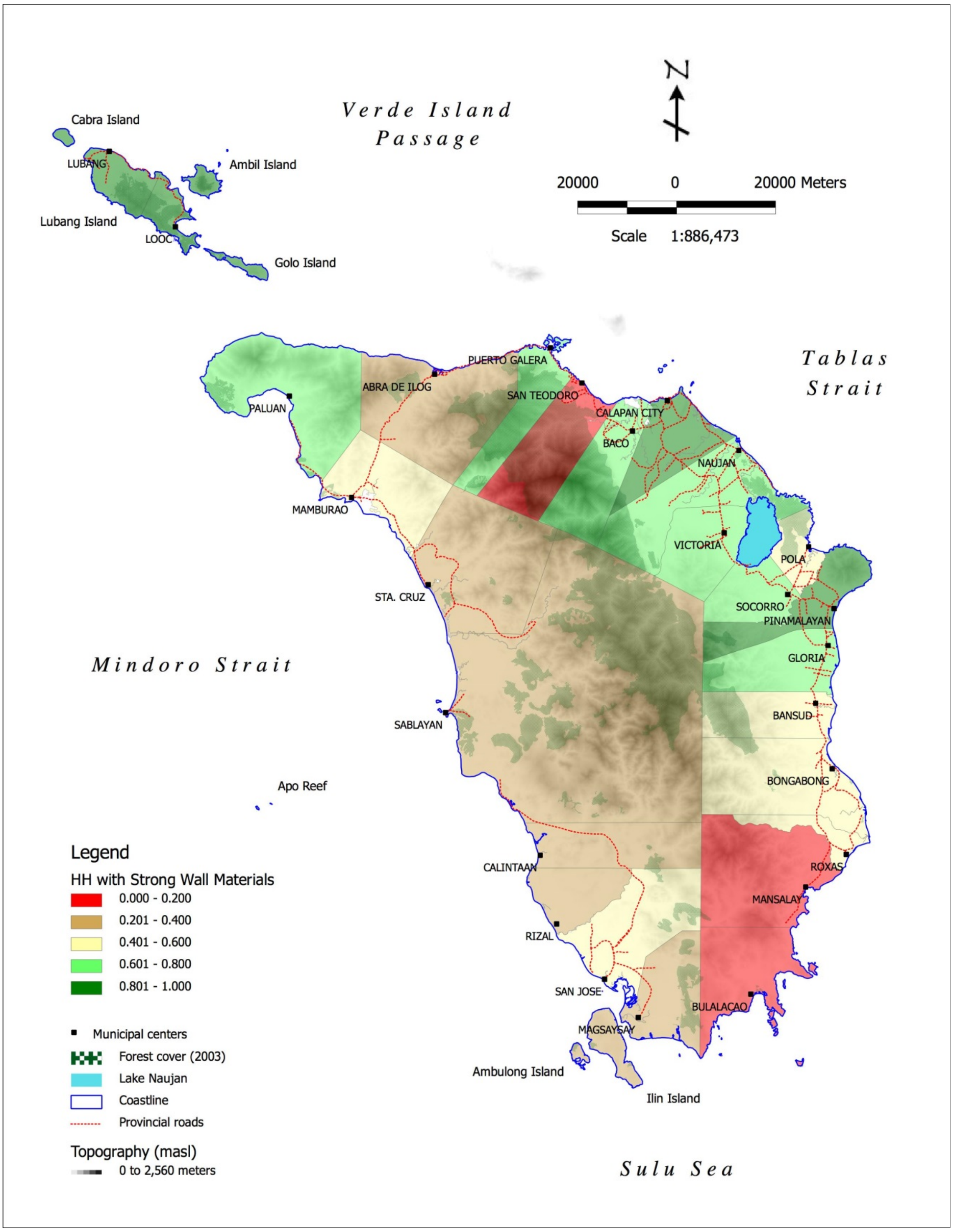


Figure 21. Households with access to electricity index results per municipality of Mindoro Island.

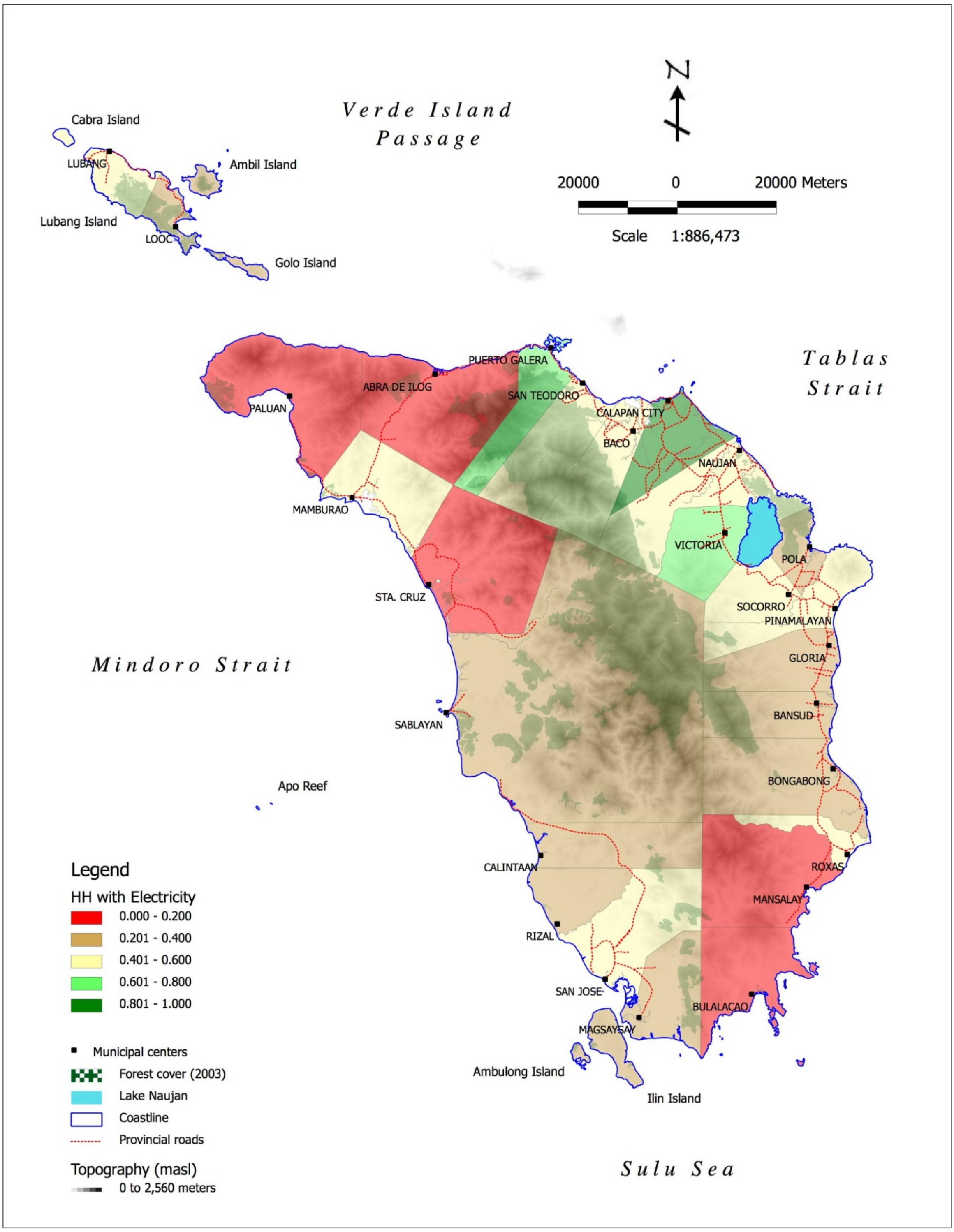


Figure 22. Households with access to sanitary toilet facilities index results per municipality of Mindoro Island.

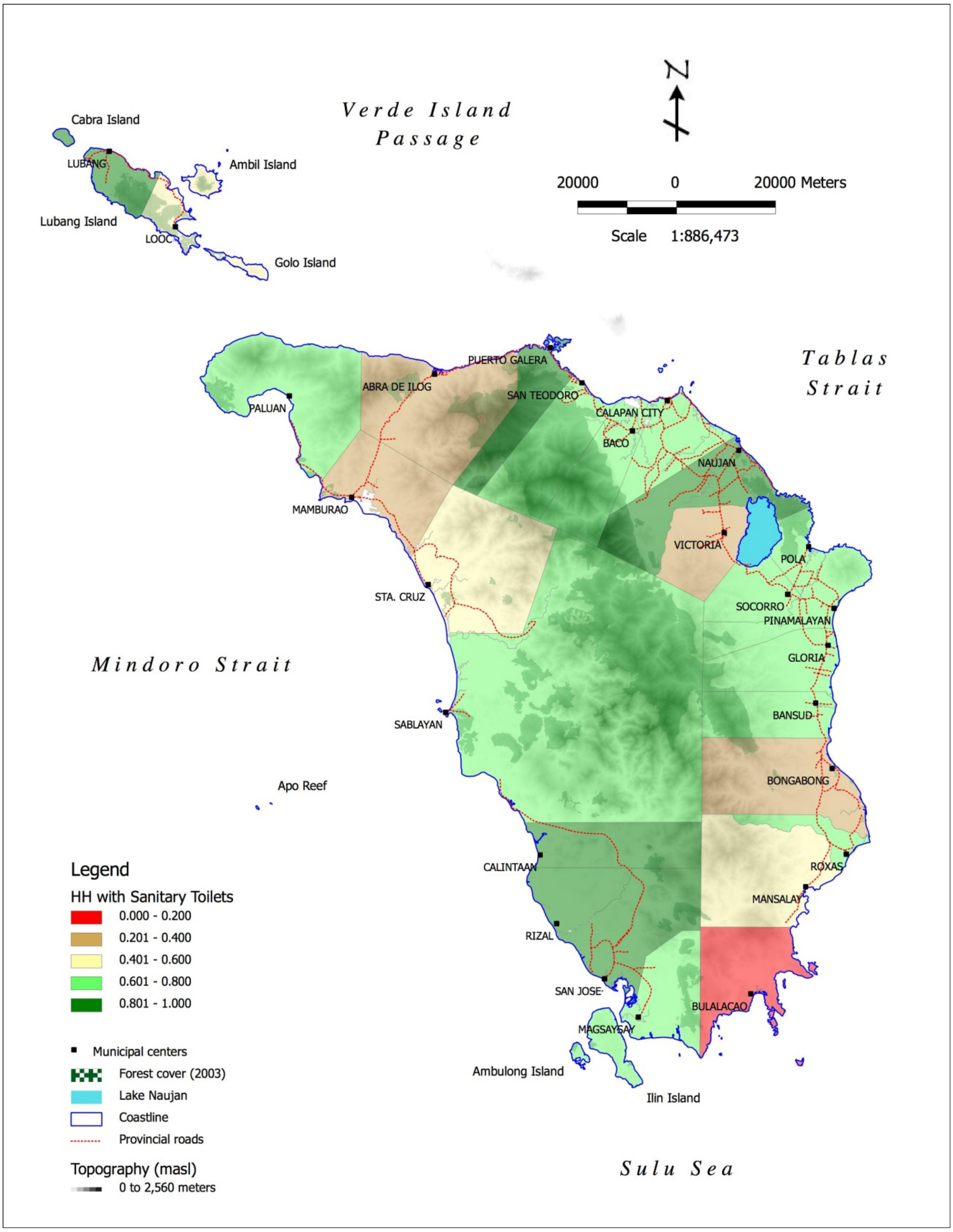


Figure 23. Households with access to safe drinking water index results per municipality of Mindoro Island.

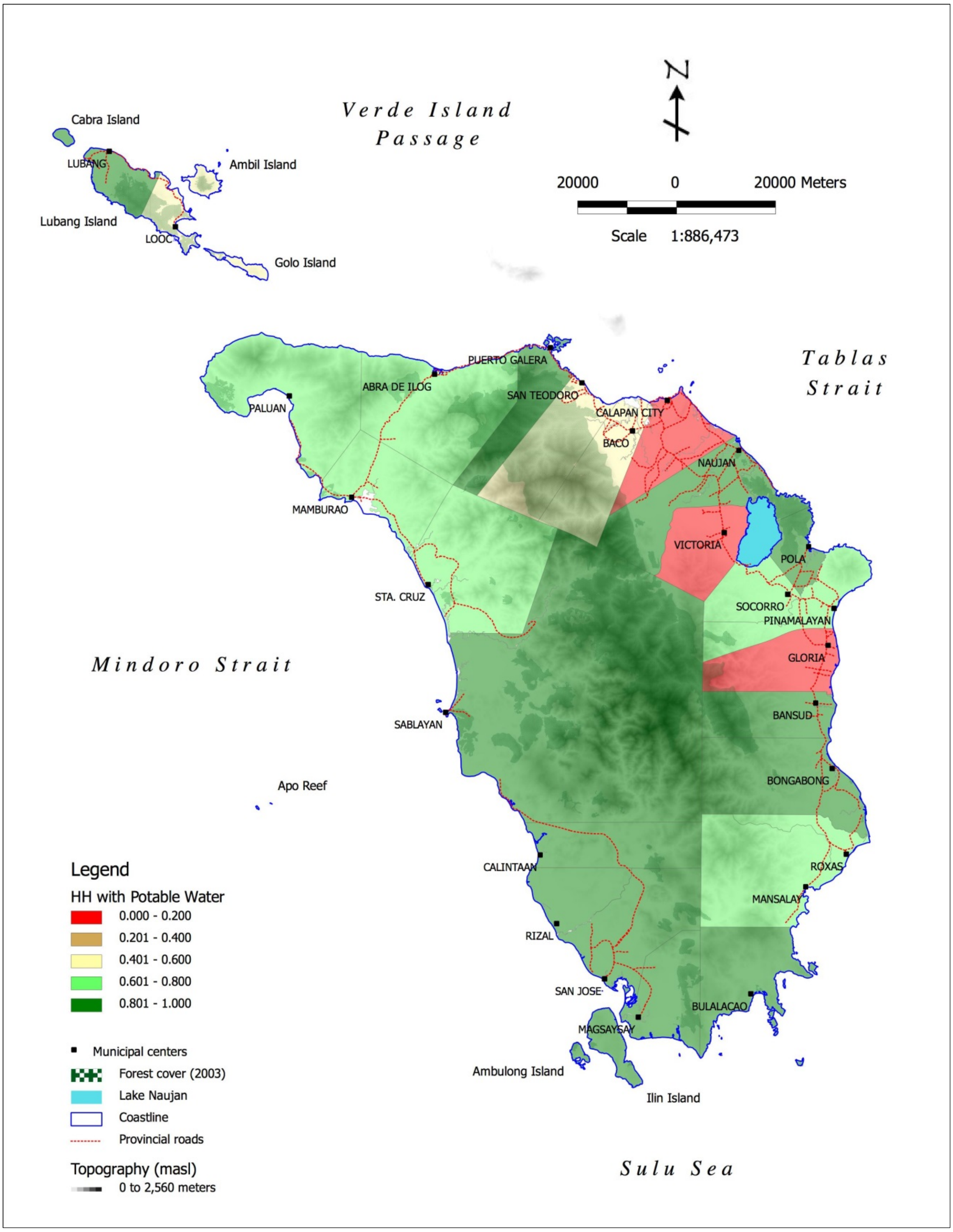


Figure 24. Households with heads that are high school graduate index results per municipality of Mindoro Island.

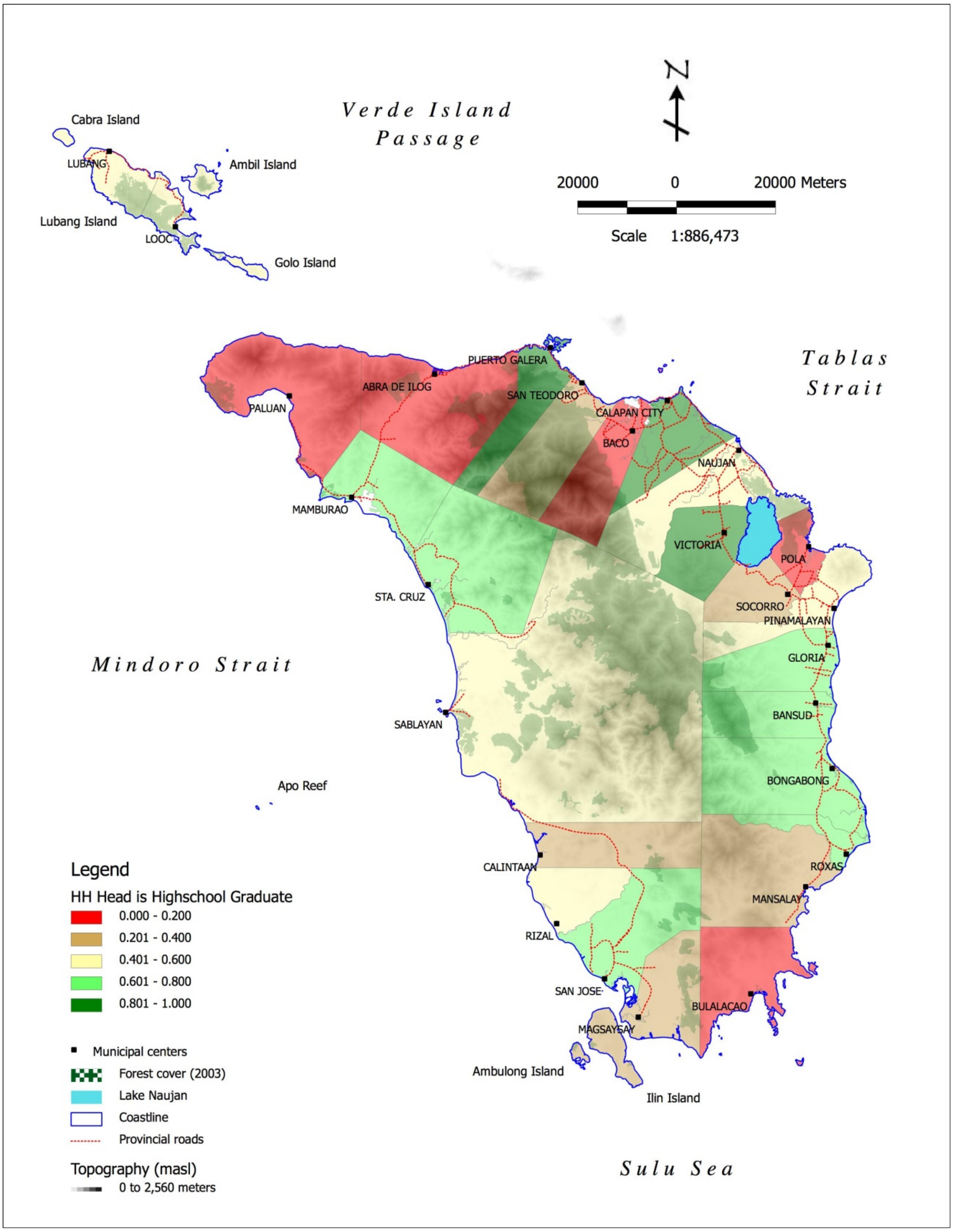


Figure 25. Households with overseas Filipino workers index results per municipality of Mindoro Island.

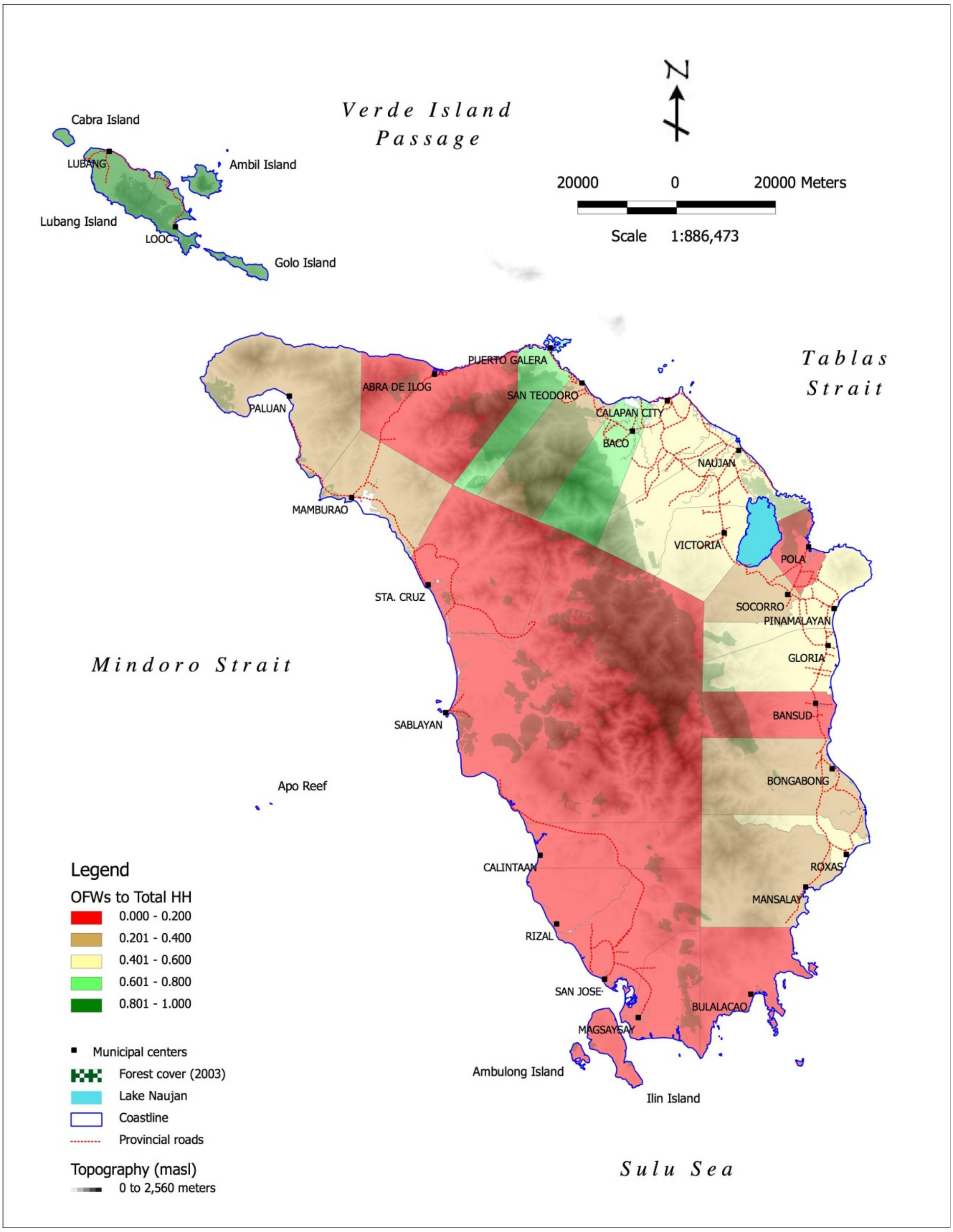


Figure 26. Proportion of elementary school attendance (ages 6-12 years old) index results per municipality of Mindoro Island.

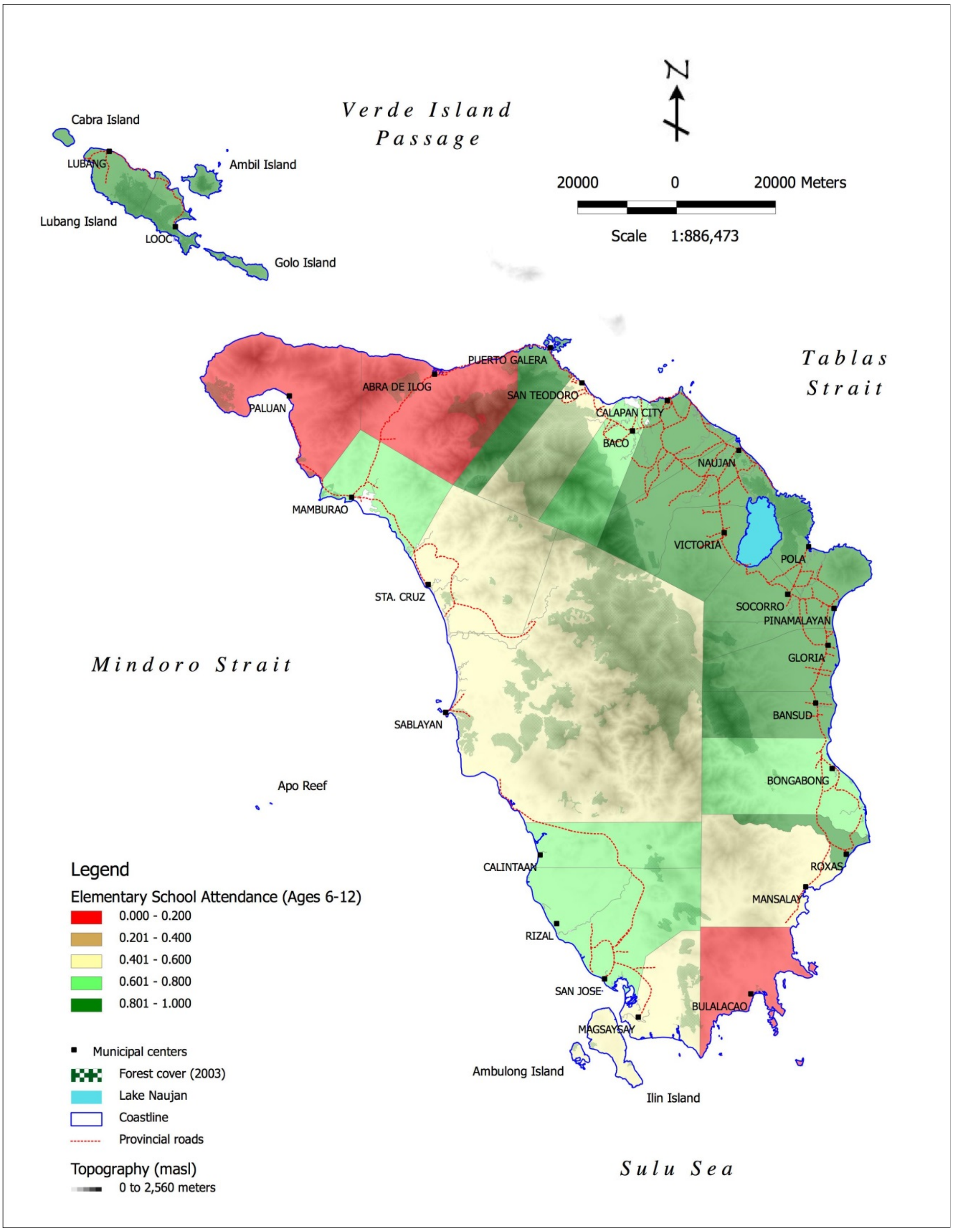


Figure 27. Proportion of high school attendance (ages 13-16 years old) index results per municipality of Mindoro Island.

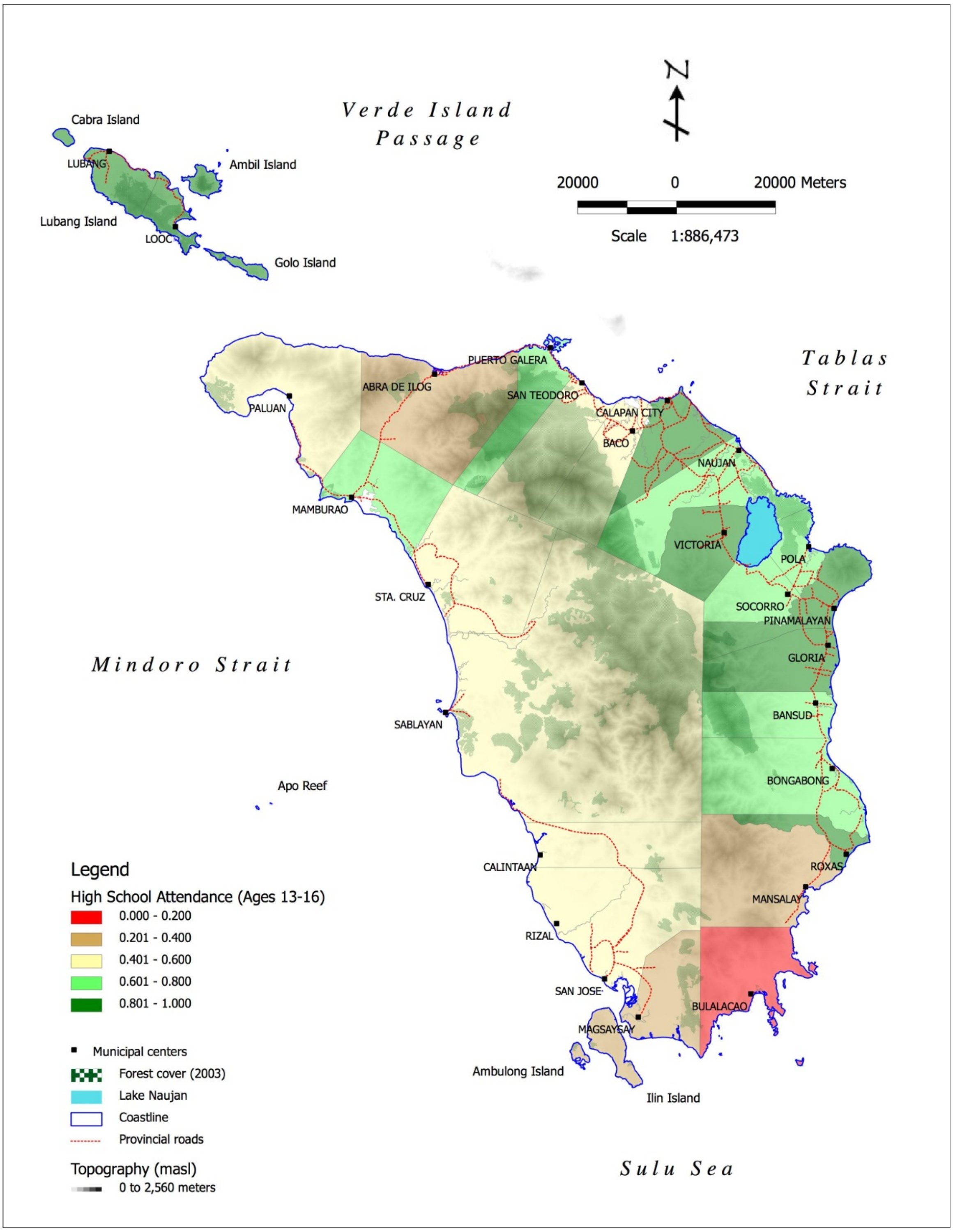
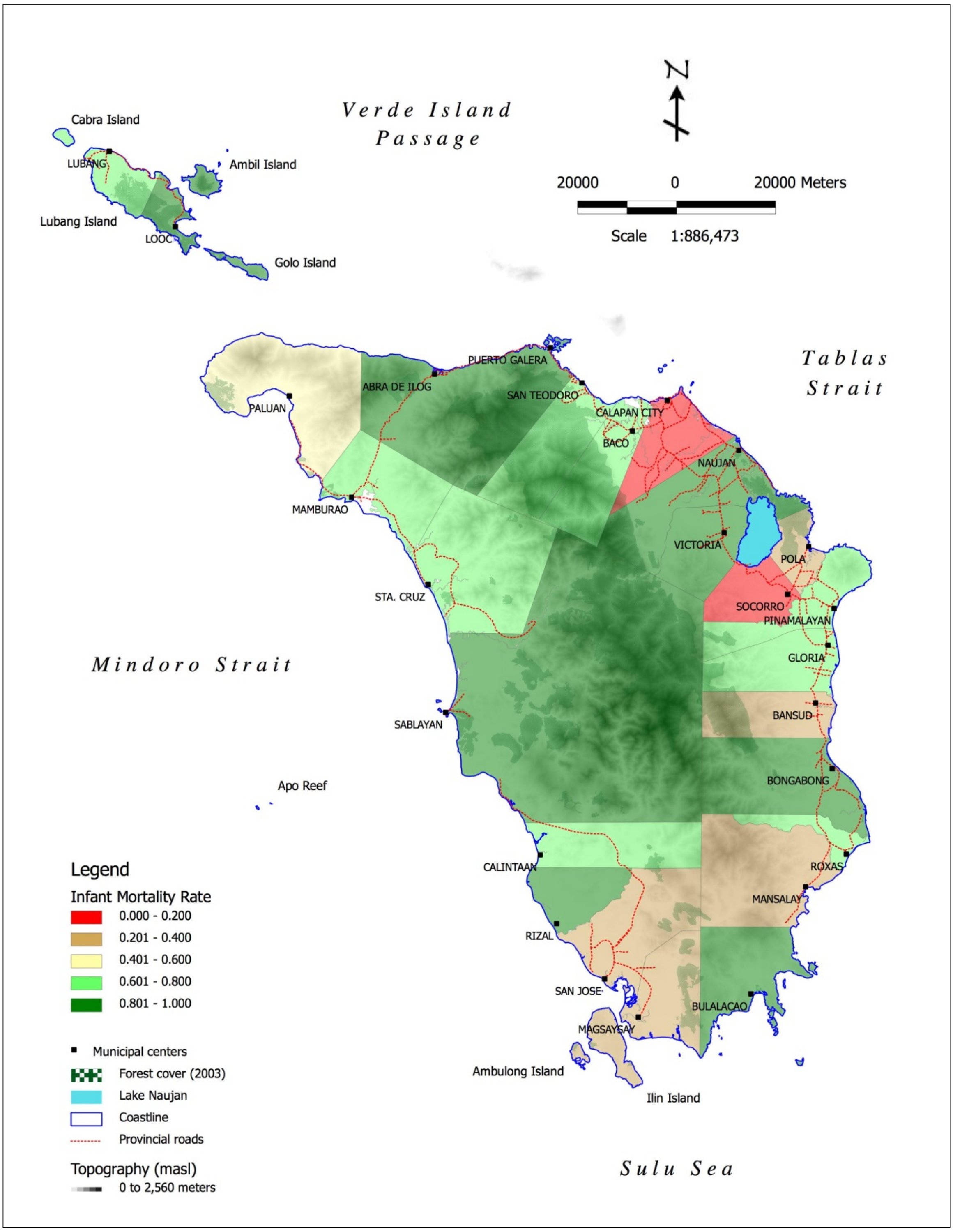


Figure 28. Infant mortality rate index results per municipality of Mindoro Island.



Annexes

Annex 1. Watershed management typologies in the Philippines (Source: PCARRD-DOST *et al*. 1999).

Type	Areal extent	Administrative coverage	Institutional coordinating agency	Type and scope of watershed management plans
	Nation	Whole Country	National Inter-agency Watershed Resources Management Forum/ National Watershed Management Body	Coordination and prioritisation of the different levels of watershed management within a national strategy framework
River Basin	Over 1000 km^2	Typically the topographic boundaries would include land occurring within 3 or more provinces and 2 or more regions	River Basin authority that is inter regional in extent	Plans aimed at broad sector development planning, and land use zoning. Identification of degraded and/or economically important medium to large watersheds within the river basin. Identification of medium-large areas in need of protected area status.
Large Watershed	500-1000 km^2	Typically the topographic boundaries would include land occurring within 3 or more provinces and at least 1 but no more than 2 regions	Regional Level Watershed Management Council that is inter provincial in extent	Plans aimed at identifying broad land use zones and areas (small to medium watersheds) where there is a need for improved watershed management. Identification of small-medium areas in need of protected area status.
Medium Watershed	100-500 km^2	Typically the topographic boundaries would include land occurring within at least 1 but no more than 2 provinces	Provincial Level Watershed Management Council	Plans aimed at identifying areas within the watershed where there is a need for field level activities. Implementation plan targets activities on only the critical parts of the watershed.
Small Watershed	10-100 km^2	Typically the topographic boundaries would fall within 1 province and include land occurring within 1 or more municipalities	Provincial/Municipal Level Watershed Management Council/Committee	Plans aimed at field level implementation of improved watershed/land management interventions. Plan covers the whole (or most of the) watershed and adjacent land of the participating communities.
Micro Watershed	Under 10 km^2	Typically the topographic boundaries would fall within 1 municipality and include land occurring within 1 or at most 2 barangays	Municipal/Barangay Community Level Watershed Management Council	Plans aimed at field level implementation of improved watershed/land management interventions. Plan covers the whole watershed and adjacent land of the participating community.

Annex 2. List of protected areas in Mindoro under the NIPAS Act (Source: PAWB-DENR. 2008).

	Protected area name	Location	Legislation	Date legislated	Land area (ha.)
Initial Components					
1	Lake Naujan National Park	Naujan, Pola, Socorro, Victoria, Mindoro Oriental	Proc. 282 Proc. 335	27-Apr-1956 25-Jan-1968	21,665.00
2	Mts. Iglit-Baco National Park	Sablayan, Mindoro Occidental Bongabong, Mindoro Oriental	RA 6148	09-Nov-1970	75,445.00
3	F.B. Harrison Game	Sablayan, Mamburao, and Paluan,	EO 9	28-Jan-1920	140,000.00

	Refuge and Bird Sanctuary	Mindoro Occidental			
4	Mindoro Mangrove Swamp Forest Reserve	Mamburao River, Buluagan River to Lagarum River, Naujan; Batel Creek, Sta. Cruz; Sablayan Point to Bagong Sabang River; Bo. Labangan to Calalayuan Point; Ilin Island; Western side of Sukol River, Bongabong; Western side of Casiliga River, Soguicay Island	Proc. 2152		
5	Mt. Kadangyasan Forest Reserve*	Baco, Calapan, and San Teodoro, Mindoro Oriental	Proc. 284 (RA 3092)	06-Aug-1964	10.360.00
Proclaimed under NIPAS Act					
5	Mt. Calavite Wildlife Sanctuary	Paluan, Mindoro Occidental	Proc. 292	23-Apr-2000	18,016.19
6	Apo Reef Natural Park	Sablayan, Mindoro Occidental	Proc. 868	06-Sep-1996	15,792.00

(Note: Information source for Mt Kadangyasan Forest Reserve is based on land classification map no. 2237)

Annex 3. List of certificate of ancestral domain titles and claims in Mindoro (Source: NCIP. 2008).

No.	Tribe	Location	No. of beneficiaries	Date issued/ approved	Land area (ha.)
Approved CADT (July 2002 to December 2004)					
	Iraya Mangyan	Sta. Cruz, Mindoro Occidental	689	30-Jan-2004	5,365.11
	Iraya Mangyan	Puerto Galera, Mindoro Oriental	2,888	28-Apr-2004	5,700.83
Claims					
9	Iraya Mangyan	Puerto Galera, Mindoro Oriental		14-Jul-1995	4,748.00
24	Alangan Mangyan	Sta. Cruz and Sablayan, Mindoro Occidental		26-Feb-1996	74,200.00
26	Iraya Mangyan	Sta. Cruz, Mindoro Occidental		26-Feb-1996	2,851.00
85	Sulodnon	Socorro and Victoria, Mindoro Oriental		23-Jun-1997	12,000.00
86	Alangan Mangyan	Naujan, Mindoro Oriental		23-Jun-1997	7,537.00
123	Tadyawan Mangyan	Gloria and Pinamalayan, Mindoro Oriental		05-Jun-1998	3,750.00
124	Alangan Mangyan	Naujan and Baco, Mindoro Oriental		05-Jun-1998	32,000.00
125	Tau-Buid Mangyan	Gloria, Socorro, and Pinamalayan, Mindoro Oriental		05-Jun-1998	21,000.00
126	Iraya Mangyan	Baco, San Teodoro, Puerto Galera, Mindoro Oriental		05-Jun-1998	33,334.00
130	Buhid Mangyan	San Jose, Rizal, Calintaan, and Sablayan, Mindoro Occidental; Bansud, Roxas, Bongabong, and Mansalay, Mindoro Oriental		05-Jun-1998	94,077.00
	Alangan Mangyan (MINSCAT)	Mindoro Oriental			101.00

Annex 4. List of mining tenements on Mindoro Island (Source: MGB-DENR. 2008).

Tenement no.	Holder / Corporation	Municipality	Area (ha.)	Date Filed	Commodity
EPA-IVB-006	Mindex Resources Development	Puerto Galera	3,159.00	06-Oct-95	gold
EPA-IVB-034	Gem Aggregates	Abra de Ilog	3,202.00	29-Sep-97	copper, gold, limestone
EPA-IVB-038	Essensa Mining	Bongabong	6,560.00	26-Oct-98	nickel, chromite
EPA-IVB-076	Shibao Mining	Mamburao	4,370.16	10-Oct-05	iron, manganese
EPA-IVB-081	Alad Mining & Development	Paluan	2,849.54	01-Jun-06	nickel, chromite
EPA-IVB-082	Highland Realty Philippines	Sta. Cruz	3,896.00	19-Jul-06	nickel, chromite, iron
EPA-IVB-084	Highland Realty Philippines	Mamburao	1,916.80	02-Aug-06	nickel, chromite, iron
EPA-IVB-085	Astrolabe Mining and Devt	Mamburao; Puerto Galera	4,078.30	04-Aug-06	iron, gold, copper

Tenement no.	Holder / Corporation	Municipality	Area (ha.)	Date Filed	Commodity
EPA-IVB-088	Agbiag Mining and Devt	Puerto Galera	1,326.02	10-Aug-05	iron, ore, manganese
EPA-IVB-095	Agbiag Mining and Devt	Looc	810.00	01-Sep-06	iron, chromite
EPA-IVB-096	East Coast Mineral Resources	Paluan	3,828.62	20-Sep-06	nickel, cobalt, chromite
EPA-IVB-101	Highland Realty Phils	Mamburao	4,161.62	26-Sep-06	ore
EPA-IVB-106	Astrolabe Mining and Devt	Abra de Ilog	459.60	20-Oct-06	iron
EPA-IVB-111	Rizal Silica	San Teodoro	2,163.78	30-Oct-06	iron, gold, copper
EPA-IVB-129	Epochina Mining	Naujan	2,996.00	29-Dec-06	iron, gold, copper
EPA-IVB-130	Epochina Mining	San Jose	2,035.00	29-Dec-06	iron, gold, copper
EPA-IVB-142	SKS Construction and Development	Sta. Cruz	4,502.83	21-Feb-07	nickel
EPA-IVB-150	Goldenpine Development	Looc	1,633.88	06-Mar-07	nickel, chromite
EPA-IVB-155	Philorient Mining	Mamburao	8,000.00	19-Mar-07	iron, manganese
EPA-IVB-159	Diamond Group of Investors	Abra de Ilog	2,746.61	27-Mar-07	nickel, chromite
EPA-IVB-160	Alad Mining and Devt	San Jose	811.06	28-Mar-07	nickel, chromite
EPA-IVB-162	Diamond Group of Investors	San Jose	3,963.13	02-Apr-07	nickel, chromite
EPA-IVB-163	JCET Resources Mining		15,328.63	03-Apr-07	nickel, chromite
EPA-IVB-166	Luckystar Integrated Mining	Sta. Cruz	2,249.61	13-Apr-07	nickel, chromite
EPA-IVB-183	APC Mining	Sablayan	2,833.97	22-May-07	gold, copper
EPA-IVB-190	Metallica Mineral Resources	Abra de Ilog; Paluan	5,913.00	04-Jun-07	gold, copper, nickel
EPA-IVB-193	Metallica Mineral Resources	San Teodoro	1,877.87	13-Jun-07	gold, copper, nickel
EPA-IVB-197	Philminer	Paluan	3,329.24	15-Jun-07	gold, copper, iron, silver
EPA-IVB-202	Goldenpine Development	Sablayan	3,312.09	20-Jun-07	gold, nickel, iron, chromite
EPA-IVB-207	T&D Kim Philippines	Paluan	2,247.24	28-Jun-07	iron, gold, copper
EPA-IVB-217	Gaas Bay Mining	Paluan	2,620.56	19-Jul-07	nickel
EPA-IVB-229	Alad Mining Development	Sablayan	1,370.00		laterite, nickel chromite
EPA-IVB-231	Ludgoron Mining	Sablayan	-	21-Aug-07	chromite
EPA-IVB-232	Ludgoron Mining	Sablayan	5,184.00	21-Aug-07	chromite
EPA-IVB-233	Khepa Mining Exploration	Sablayan	6,075.00	21-Aug-07	chromite
EPA-IVB-241	Mount Baua Mining	Lubang	9,312.00	17-Aug-07	silica, quartz, copper
EPA-IVB-246	Gaas Bay Mining	Mamburao	3,163.06	03-Oct-07	iron
EPA-IVB-260	Czarstone Mining	Sablayan	1,302.86	09-Nov-07	nickel, chromite
EPA-IVB-264	Imelda Cruz	Bongabong; Pinamalayan	2,291.74	28-Nov-07	nickel, iron, etc
PMPSA-IVB-035	Philippine Marble	Abra de Ilog	112.00	26-Jun-92	aggregates, marble
PMPSA-IVB-057	Orophil Stonecraft	San Teodoro	748.95	04-Nov-92	gold, silver, nickel
PMPSA-IVB-069	Kantoh International Marble	San Teodoro	1,165.81	22-Feb-93	marble
PMPSA-IVB-070	Philippine Sunrise Marble	San Teodoro	332.88	17-Jun-95	marble
PMPSA-IVB-082	San Teodoro Marble	San Teodoro	712.03	28-May-93	marble
PMPSA-IVB-105	Zipporah Mining & Devt	Abra de Ilog	480.68	09-Jan-93	feldspar
PMPSA-IVB-139	General Cement	Magsaysay	1,962.94	20-Sep-94	limestone
PMPSA-IVB-216	General Cement	Mansalay	770.16	03-Jul-95	limestone
PMPSA-IVB-234	Blue Ridge Mining	Bongabong	2,112.00	01-Sep-95	nickel
FTAA-IVB-004	Kanlaon Mining	Sablayan	293,624.10	26-Feb-94	gold, silver
FTAA-IVB-005	Agusan Petroleum and Mining	Abra de Ilog	53,952.00	26-Feb-94	gold, silver
FTAA-IVB-006	Royal Cement and Mining	Roxas	53,136.00	26-Feb-94	gold, silver
IPA-(SG)-016	Wilson Kho	San Jose	20.00	29-Mar-99	sand, gravel
IPA-(SG)-033	Bridgestone Mining and Development	Calintaan	19.16	05-Mar-02	sand, gravel
IPA-(SG)-038	Lazaruz Mining	Calintaan	19.15	05-Mar-02	sand, gravel
IPA-(SG)-039	Cypress Mining and Development	Sta. Cruz	19.26	05-Mar-02	sand, gravel
IPA-(SG)-040	Liverpool Mining and Devt	Sta. Cruz	19.68	05-Mar-02	sand, gravel
IPA-(SG)-041	Daytona Mining and Devt	Sablayan	19.21	07-Apr-02	sand, gravel
AMA-IVB-007	Everest Cement & Mining	San Jose	4,319.00	28-Dec-95	limestone

Tenement no.	Holder / Corporation	Municipality	Area (ha.)	Date Filed	Commodity
AMA-IVB-014	Kalamanzoo Mining	San Jose	8,074.00	22-Jan-96	limestone
AMA-IVB-032	Jesus Manlulu	Puerto Galera	16.80	19-Jun-96	marble
AMA-IVB-051	Mansalay Mining	Mansalay	3,291.00	04-Sep-96	silica
AMA-IVB-059	First Omega Mining and Development	San Teodoro	243.00	31-Oct-96	gold, copper
AMA-IVB-067	Glendale Mining and Devt	Victoria	648.00	16-Apr-97	bullquartz
AMA-IVB-071	Rebecca Mendoza	Lubang	128.31	08-Sep-97	marblelized limestone
AMA-IVB-080	Leonila Salas	Mansalay	243.00	15-Sep-97	silica sand
AMA-IVB-088	Daytona Mining and Devt	Puerto Galera	1,414.00	01-Oct-97	marble
AMA-IVB-093	Silverbell Mining and Devt	Naujan	1,748.55	18-Sep-96	sulphur
AMA-IVB-094	Lazaruz Mining	Bongabong	1,252.29	06-Nov-98	silica
AMA-IVB-095	St. Patrick Mining & Devt	Mansalay	4,374.00	06-Nov-98	silica
AMA-IVB-097	Aglubang Mining	Victoria; Naujan	863.91	13-Nov-98	nickel
AMA-IVB-099	Romulo R. Reyes	Abra de Ilog	810.00	10-Dec-98	marble
AMA-IVB-100	Rockworks Inc.	Pinamalayan	3,338.00	22-Jan-99	basalt, andesite
AMA-IVB-101	Alagag Mining	Sablayan	3,376.00	09-Feb-99	nickel
AMA-IVB-103	Aglubang Mining	Sablayan	4,596.00	05-Mar-99	nickel
AMA-IVB-105	Silverbell Mining and Devt	Bongabong	5,832.00	04-Oct-99	bentonite
AMA-IVB-119	Chemdyes Mining & Alloys	Looc	128.00	01-Dec-01	bullquartz
AMA-IVB-120	Chemdyes Mining & Alloys	Looc	240.00	01-Dec-01	bullquartz
AMA-IVB-121	Aglubang Mining	Victoria	2,290.67	07-Dec-00	nickel
AMA-IVB-132	Starrex Mining and Devt	Mamburao	1,040.00	22-Aug-01	sand, gravel
AMA-IVB-133	Eagle Crest Mining & Devt	Sablayan	99.63	22-Aug-01	sand, gravel
AMA-IVB-135	Hopewell Mining	San Jose	100.00	22-Aug-01	sand, gravel
AMA-IVB-136	Liverpool Mining and Devt	Sablayan	99.99	22-Aug-01	sand, gravel
AMA-IVB-137	Oregon Mining and Devt	Rizal	100.00	24-Aug-01	sand, gravel
AMA-IVB-138	Eagle Crest Mining & Devt	Mamburao	99.99	24-Aug-01	sand, gravel
AMA-IVB-139	Starrex Mining and Devt	Sta. Cruz	648.00	18-Dec-01	clay
AMA-IVB-140	Bridgestone Mining & Devt	Sta. Cruz	405.00	18-Dec-01	clay
AMA-IVB-141	Lazaruz Mining	Sta. Cruz	648.00	18-Dec-01	clay
AMA-IVB-142	Sardonyx Resources Intl	Looc	928.32	10-Oct-02	silica rock & sand
AMA-IVB-148	Baegil Resources	Abra de Ilog	2,038.78	01-Oct-04	iron ore, marble
AMA-IVB-150	Baegil Resources	Abra de Ilog	749.00	01-Dec-04	iron, marble
AMA-IVB-152	Vic-Soc Mining	Socorro	3,969.00	03-Mar-05	gold
AMA-IVB-159	Dayap Mining	Mamburao	2,500.00	17-May-05	iron, etc

Annex 5. Partial list of community-based forest management areas in Mindoro.

CBFM holder	Location	Land area (ha.)
Balatbat Rural Workers CBFM Association Inc.	Bulalacao, Mindoro Oriental	2,936
Cambunang CBFM Association Inc.	Bulalacao, Mindoro Oriental	172
Mangyan Pagpapaunlad CBFM Association Inc.	Bulalacao, Mindoro Oriental	1,519
Pundasyon Hanunuo Mangyan Inc.	Bulalacao, Mindoro Oriental	3,356
Samahan ng mga Mangyan Iraya sa Barangay Baras	San Teodoro, Mindoro Oriental	1,113
--	San Teodoro, Mindoro Oriental	594
Palbong CBFM Association Inc.	Sablayan, Mindoro Occidental	545

Annex 6. Overall poverty index matrix of municipalities in Mindoro.

Municipality	Overall Index	A	B	C	D	E	F	G	H	I	J
Mindoro Occidental											
Abra de Ilog	0.32	0.29	0.30	0.19	0.28	0.72	0.00	0.18	0.00	0.25	1.00
Calintaan	0.48	0.34	0.32	0.21	0.81	0.86	0.40	0.13	0.61	0.46	0.67
Looc	0.71	0.91	0.91	0.23	0.55	0.41	0.52	1.00	0.90	0.81	0.85
Lubang	0.83	0.89	0.98	0.46	1.00	0.88	0.57	0.94	0.91	1.00	0.63
Magsaysay	0.45	0.59	0.32	0.23	0.61	1.00	0.33	0.08	0.59	0.35	0.40
Mamburao	0.56	0.65	0.55	0.51	0.26	0.72	0.60	0.26	0.74	0.64	0.69
Paluan	0.41	0.46	0.62	0.01	0.70	0.67	0.19	0.37	0.14	0.42	0.56

Rizal	0.58	0.61	0.33	0.24	0.88	1.00	0.48	0.15	0.80	0.45	0.80
Sablayan	0.51	0.42	0.29	0.33	0.73	0.94	0.43	0.14	0.49	0.48	0.84
San Jose	0.59	0.81	0.57	0.52	0.86	0.95	0.67	0.11	0.62	0.59	0.23
Santa Cruz	0.43	0.22	0.25	0.18	0.55	0.70	0.60	0.00	0.59	0.45	0.74
Mindoro Oriental											
Baco	0.61	0.81	0.70	0.42	0.64	0.56	0.16	0.73	0.73	0.58	0.77
Bansud	0.59	0.62	0.54	0.37	0.73	1.00	0.62	0.20	0.82	0.68	0.30
Bongabong	0.54	0.49	0.41	0.36	0.37	0.80	0.65	0.24	0.63	0.61	0.80
Bulalacao	0.21	0.00	0.00	0.00	0.00	1.00	0.09	0.06	0.02	0.00	0.94
Calapan City	0.72	1.00	1.00	1.00	0.76	0.03	1.00	0.50	1.00	0.94	0.01
Gloria	0.60	0.55	0.73	0.39	0.75	0.00	0.65	0.49	0.81	0.85	0.77
Mansalay	0.32	0.12	0.14	0.10	0.45	0.67	0.33	0.24	0.48	0.37	0.28
Naujan	0.74	0.81	0.72	0.55	0.97	1.00	0.52	0.50	0.87	0.61	0.87
Pinamalayan	0.68	0.77	0.81	0.58	0.63	0.74	0.56	0.42	0.87	0.86	0.61
Pola	0.55	0.63	0.60	0.34	0.76	0.96	0.11	0.17	0.97	0.68	0.26
Puerto Galera	0.84	0.82	0.69	0.78	0.96	1.00	0.82	0.77	0.89	0.63	1.00
Roxas	0.66	0.61	0.51	0.43	0.77	0.73	0.67	0.52	0.82	0.81	0.74
San Teodoro	0.48	0.63	0.15	0.49	0.67	0.53	0.21	0.37	0.60	0.54	0.62
Socorro	0.56	0.92	0.72	0.44	0.66	0.68	0.22	0.35	0.89	0.75	0.00
Victoria	0.70	0.92	0.77	0.65	0.28	0.12	0.98	0.57	0.95	0.83	0.92
ISLAND AVERAGE	0.56	0.61	0.54	0.38	0.64	0.72	0.48	0.36	0.68	0.60	0.63

LEGEND	**Rank**	1 Highest	2 High	3 Moderate	4 Low	5 Lowest
	Range	0.81 to 1.00	0.61 to 0.80	0.41 to 0.60	0.21 to 0.40	0.00 to 0.20

Code	Indicator	Source
A	HH with dwelling units with strong roofing materials	National Statistics Office, 2000, Census of Population and Housing
B	HH with dwelling units with strong wall materials	National Statistics Office, 2000, Census of Population and Housing
C	HH with electricity	Occidental Mindoro Provincial Planning and Development Office, 2007; National Electrification Administration & Oriental Mindoro Electric Cooperative, 2008
D	HH with access to sanitary toilet	Occidental Mindoro Provincial Health Office, 2009; Oriental Mindoro Provincial Planning and Development Office, 2009
E	HH with access to potable water	Occidental Mindoro Provincial Health Office, 2009; Oriental Mindoro Provincial Planning and Development Office, 2009
F	HH head is high school graduate at least	National Statistics Office, 2000, Census of Population and Housing
G	OFWs to total number of HH	National Statistics Office, 2000, Census of Population and Housing
H	Elementary school attendance (ages 6-12)	National Statistics Office, 2000, Census of Population and Housing
I	High school attendance (ages 13-16)	National Statistics Office, 2000, Census of Population and Housing
J	Infant mortality rate	Occidental Mindoro Provincial Health Office, 2009; Oriental Mindoro Provincial Planning and Development Office, 2009

Note: Index values were computed based on available data. The number of households (HH) was taken from either 2000 or 2009, depending on availability. 2000 HH data was derived from the NSO Census of Population and Housing (for computing the index values of indicators A, B, F, G, H, I); 2009 HH data was derived from the Provincial Planning and Development Offices of both provinces (for computing the index values of indicators D, E).