



**SELINUS UNIVERSITY**  
OF SCIENCES AND LITERATURE

**A STRATEGIC APPROACH  
TO THE MANAGEMENT AND  
CONSERVATION  
OF SELECTED WATERSHEDS  
IN MINDANAO**

By  
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**A DISSERTATION**

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Urooj Malik  
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The Philippines

## **ABSTRACT**

**TITLE OF RESEARCH** : A STRATEGIC APPROACH TO THE  
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**EXECUTIVE SUMMARY:**

The Philippine watershed ecosystem is in the grip of a complex, multidimensional crisis that has five main features: a highly degraded environment, decades of watershed mismanagement, extreme vulnerability to a host of environmental threats, low agricultural productivity coupled with rapid population growth, all exacerbated by climate change.

This study focuses on selected watersheds in Bukidnon and Lanao del Sur in north-central Mindanao. These watersheds are of strategic importance to the whole of Mindanao because they are the headwaters from which six major rivers that flow to the surrounding provinces and regions originate. They are centrally located in the high mountain ranges that are the dominant feature of Bukidnon and Lanao del Sur. The rivers that emanate from them flow in a north and south axis and drain into four major bays to the north and south of the island of Mindanao.

These rivers sustain much of the agricultural and commercial activity in the areas they traverse and have been the nucleus from which now thriving highly urbanized coastal settlements such as the cities of Cagayan de Oro and Iligan grew. Their strategic importance is illustrated further by Mindanao's dependence on hydropower for electricity generation. However, full economic development is stymied by insufficient power supply that leads to lengthy power outages during the dry season.

Based on this crisis situation, plus a consideration of the current laws and government agencies involved in watershed management, as well as a survey of the

approaches used by various organizations, this study proposes a strategic approach to the management and conservation of the six selected watersheds in the mountain ranges of Bukidnon and Lanao del Sur.

The urgency of carrying out this management and conservation program cannot be emphasized enough. In December 2011, the watershed crisis situation was chillingly illustrated when the super typhoon “Sendong” disaster struck the cities of Cagayan de Oro and Iligan. The Sendong disaster is only the most recent and most ominous warning sign that things are likely to get worse. The long-term challenges of effectively managing our ecosystems, including the threat of climate change impacts, must be addressed now and with a higher degree of dedication and passion. The nature of watershed management and conservation is complex and its full benefits can be realized only after a long gestation period. Hence, there is a higher sense of urgency, and this may well be our last fighting chance before the ill effects of the watershed crisis become irreversible.

The strategic approach calls for a long-term, sustainable rainforestation program in the watersheds located in the upper river basins of Bukidnon and Lanao del Sur that would avoid the pitfalls and shortcomings of other programs attempted previously. The strategic approach encompasses the following key features:

- Strong regional and local government ownership and support, in coordination with the national and international agencies;
- Community leadership and ownership, and the prospects for increasing private sector participation;

- Provision of long-term livelihood and marketing opportunities for Indigenous People and Moro (Muslim) communities living in and around the buffer zones of the mountain ranges;
- Use of best practices in agroforestry and sustainable natural resource management;
- Application of state of the art geographic information systems (GIS) technology;
- Initiatives for ensuring that longer-term capacity-building and project management efforts will be set in place; and
- Formulation of long-term “road map” through the preparation of a strategic action plan for a reforestation program in the upper river basins and watersheds.

The study discusses and illustrates these features for ensuring longer-term sustainability of a reforestation program based on the strategic approach, including the use of tested management tools such as a Strengths-Weaknesses-Opportunities-Threats (SWOT) Analysis and Kotter’s Eight Phases of Managing Change, and sets forth specific recommendations.

The recommendations have fundamental, far-reaching effects that are necessary if any reforestation strategy is to succeed. The recommendations, among others, include:

- The use of the watershed as the basic planning unit, not political boundaries;

- Widespread engagement with the communities and private sector for promoting the implementation of a payment for environmental services scheme;
- The use of Calliandra or other similar species to tackle Cogon and Talahib grasses in order to combat grass fires and prepare the soil for the re-introduction of native tree species;
- Adequate funding over the long run that will ensure project sustainability and the assurance of long-term livelihood opportunities for the mountain forest communities; and
- The enhancement of the Government's current National Greening Program to fund a true reforestation in the watersheds of the upper river basins.

Implementation of the strategic approach to the reforestation of selected watersheds in Bukidnon and Lanao del Sur shall stabilize the hydrological cycle, increase availability of water for irrigation, hydroelectric power and human consumption, and enhance carbon absorption capacity – thereby also mitigating the ever-growing threat of climate change.

Without a serious and concerted effort to implement the strategic approach on an urgent basis, the watershed ecosystem crisis situation will only progressively worsen at a faster pace with a gathering and looming danger for another Sendong to strike without notice. Chances are that, considering the worsening situation of mountain ranges and watersheds, the next one is likely to be a “big one” with even more devastating impact on infrastructure, agriculture and human life.

**DEDICATION**

IN MEMORY OF MY BELOVED LATE PARENTS,

BEGUM AFZAL MALIK AND MR. GHULAM MOHAMMAD (GM) MALIK

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## ACRONYMS AND ABBREVIATIONS

- ADB – Asian Development Bank
- AO – Administrative Order
- ARMM – Autonomous Region of Muslim Mindanao
- BFD – Bureau of Forest Development
- CBFM – Community-Based Forest Management
- CFPC – CARAGA Forest Plantation Corridor
- cu – cubic
- DA – Department of Agriculture
- DENR – Department of Environment and Natural Resources
- DILG – Department of Interior and Local Government
- DPWH – Department of Public Works and Highways
- EMB – Environment Management Bureau
- EO – Executive Order
- EVI – Environmental Vulnerability Index
- FMB – Forest Management Bureau
- FSP – Forestry Sector Program
- FTAA – Financial or Technical Assistance Agreement
- GDP – Gross Domestic Product
- GHG – greenhouse gas
- GIS – geographic information system
- GMS – Greater Mekong Sub-Region
- GNP – Gross National Product
- ha – hectare
- HFI – Hineleban Foundation, Inc.
- IEC – information education communication
- IFMA – Integrated Forest Management Agreement
- IP – indigenous people
- IPCC – Intergovernmental Panel on Climate Change
- IPRA – Indigenous Peoples Rights Act
- IRA – Internal Revenue Allotment

ISF – Integrated Social Forestry

IWMC – Illinois Watershed Management Clearinghouse

km – kilometer

LGU – local government unit

LOI – Letter of Instruction

LWUA – Local Water Utilities Administration

m – meter

M – Million

MA – Mineral Agreement

MLGU – Municipal Local Government Unit

mm – millimeter

NEA – National Electrification Administration

NGP – National Greening Program

NIA – National Irrigation Authority

NIPAS – National Integrated Protected Areas System

NCR – National Capital Region

NPC – National Power Corporation

NWRB – National Water Resources Board

PAGASA – Philippine Atmospheric, Geophysical and Astronomical Services  
Administration

PAWB – Protected Areas Wildlife Bureau

PCARRD – Philippine Council for Agriculture, Forestry and Natural Resources  
Research and Development

PD – Presidential Decree

PEARL – Program for Equitable Advancement of Rural Livelihood

PES – payment for environmental services

PLGU - Provincial Local Government Unit

RA – Republic Act

SALT – sloping agricultural land technology

SEARCA – Southeast Asian Regional Center for Graduate Study and Research in  
Agriculture

SWIM – Small Water Impounding Management

SWOT – Strengths Weaknesses Opportunities Threats

t – tons

TLA – Timber License Agreement

TPSA – Timber Production Sharing Agreement

UN – United Nations

UNEP – United Nations Environment Programme

UPLB – University of the Philippines at Los Baños

URB – upper river basin

USA – United States of America

WB – World Bank

yr – year

## CHAPTER 1

### THE PROBLEM AND ITS SETTING

#### 1.1 Introduction

Decades of mismanagement and a host of other problems have beset the Philippine watershed ecosystem and brought it to a crisis that is now coming to a head. This crisis situation is characterized by unmitigated climate change, food security problems, poverty and economic hardship, community displacement, and extreme vulnerability to natural disasters.

This crisis situation jolted the national consciousness once more when Typhoon Sendong devastated the Northern Mindanao cities of Cagayan de Oro and Iligan, by happenstance directly proximate to this paper's area of study. Thus, this research discusses the current state of the environment, impacts and vulnerability risks, leading to the formulation of sustainable development strategies to manage and conserve selected watersheds on the island of Mindanao in the Philippines.

The National Statistics Office (2008) declared that watershed degradation in the upper river basins (URBs), with its consequent impacts on agricultural productivity, is a significant contributor to poverty and loss of livelihood. The poverty incidence in the Philippines over the past decade or so has been persistently high and consistently ranged between 18%-25%. On the island of Mindanao, however, poverty incidence in most of its provinces is double that of the national

level, ranging between 40% to 50%. This is especially the case for the provinces covered in this study, namely Bukidnon and the Bangsamoro Autonomous Region.<sup>1</sup>

Rincon and Virtucio conclude that in rural areas where economic production is largely based on land and natural resources, poverty and environmental degradation form a vicious cycle. Environmental degradation accounts for about 75% of total poverty in the country. Most of the rural poor are dependent on agriculture and natural resources for their livelihood and are, thus, the most vulnerable to climate change. The country's vulnerability to natural hazards is closely linked to poverty and environmental degradation. Risks from global climate change are expected to further exacerbate vulnerability of the poor to natural hazards.<sup>2</sup>

The Asian Development Bank reports that it has been observed that steadily growing population pressure, displacement of marginal farmers and indigenous peoples (IPs) with traditional stewardship patterns in resource management, and the lack of legal and practical mechanisms for resource protection, all lead to conversion of forest land into marginal upland farming.<sup>3</sup>

The Upland Development Program Database of the Forest Management Bureau (FMB) shows that over the last several decades, forest areas in the URBs have experienced severe deforestation. Mountain slips, landslides, flash floods, and massive soil erosion and siltation of vital river systems are now common

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<sup>1</sup> Philippines Statistics Office, various issues (2005-2019).

<sup>2</sup> Rincón, M. F. G. and Virtucio, F. K., Jr. (2008). *World Bank Country Environmental Analysis*. Unpublished discussion draft.

<sup>3</sup> Asian Development Bank (2008). *Country Environmental Analysis*. Manila: Unpublished draft.

phenomena in the country. In the absence of appropriate land use planning and zoning, watershed degradation is compounded by inappropriate conversion of forestlands into unsuitable forms of agriculture and swidden farming or “kaingin,” rampant quarrying and mining, forest fires, and illegal logging. A sizeable portion of the country's agriculture is practiced on land that is not suitable for crop cultivation especially in URBs, causing accelerated soil erosion and loss of productivity resulting in an estimated soil loss of between 74 and 81 million tons per year, affecting as much as 77% of the country’s land area.<sup>4</sup>

The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), which conducted simulation studies on watersheds, has shown that increasing the cropped area in watersheds results in increased sediment yields. Sediment yield ranges from 1.09 tons per hectare (ha) per year when the watershed is covered by trees or grasses, 11.1 tons/ha/yr when 20% of land use in the watershed consists of corn, sugarcane, and vegetables interspersed with grasses, and increases to 19.9 tons/ha/yr if 50% of the watershed is under the same land use.<sup>5</sup>

Apart from opportunity costs associated with foregone earnings from poorly managed land, soil erosion has imposed high costs on downstream sectors – roads,

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<sup>4</sup> Forest Management Bureau (2009). Upland Development Program Database. Retrieved from forestry.denr.gov.ph

<sup>5</sup> PCARRD 2005. Highlights 2004, Los Banos, Laguna. Predicting soil erosion and sediment yield in small upland watersheds in the Philippines using the WEPP computer simulation model.

bridges, agricultural production areas, settlements, water districts, etc. (Mittermeier et al)<sup>6</sup>

For example, the Lake Lanao Development Plan reports that accelerated soil erosion has reduced the storage capacity of reservoirs and as much as 30% reduction in service areas of irrigation systems during dry season. Silting of rivers and lake systems has caused the shortening of reservoir lifespans affecting both hydroelectric power and water supply. The Lake Lanao URB is a major provider of hydropower for the Mindanao region and studies have shown that as a result of reduced water flow from the lake, power output is currently only about 50% of installed capacity resulting in lost revenue for the National Power Corporation of around US\$11 million annually.<sup>7</sup>

According to the World Bank, Philippine deforestation during in recent years was estimated at about 2.2% annually of the 7.1 million hectares or about 150,000 hectares per year, very high compared to the deforestation rates in other countries.

A similar estimate is made by Acosta, whose figures show a steady decline in the closed canopy (old growth) forests over the past two decades, with the area reduced from about 5.5 million hectares in 1988 to just 2.5 million hectares in 2003 or about 8% of the land area of the country,<sup>8</sup> extremely low by regional standards.

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<sup>6</sup> Mittermeier, R.A., Robles Gil, P. and Mittermeier, C.G. (1997). *Megadiversity Earth's Biologically Wealthiest Nations*. CEMEX, Monterey, Mexico. 501 pp.

<sup>7</sup> The estimate is based on the information presented in the Lake Lanao Integrated Development Plan 2003, using the rate of PhP 0.5/KwH. The retail price of power in Mindanao is Php3.00/KwH (NPC Website)

<sup>8</sup> Acosta, R. (2005). *State of the Philippine Forests: the National Forest Assessment of 2003*. Presentation at the Philippines Forestry Forum, 2-3 June 2005. Manila, Asian Development Bank.

This reduction of more than 200,000 hectares annually or an annual rate of around 3.6% is indicative of the level of forest degradation, contributing to greenhouse gas (GHG) emissions.

Cruz says that the primary concern of watershed management is to organize and guide the use of land and other watershed resources to ensure the sustainability of water, soil and the flux of watershed goods and services. The task is never easy even when there is only one resource to consider, but it is definitely simpler than having to deal with a watershed where resources and users are numerous and diverse. In most watersheds in the Philippines, management is complicated not only by the intricate relationships of the various watershed resource values to different users. A watershed manager has to contend with the usually opposing and competing interests in the watershed resources. This is a daunting responsibility that normally entails balancing the demands for watershed resource protection and socioeconomic development, and harmonizing the efforts to undertake varying productive activities.<sup>9</sup>

The importance of watershed management is reinforced by Cruz et al's creation of a guidebook which presents a comprehensive discussion of the general and specific guidelines for the preparation and implementation of watershed management plans consistent with the current thrusts of the DENR and as embodied in the Philippine Strategy for Improved Watershed Resources Management crafted through the Watershed Management Improvement Component of the Water

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<sup>9</sup> Cruz, R. V. O. (2001). *Watershed Resources Management: A Training Manual*. A joint publication of the College of Forestry and Natural Resources, University of the Philippine Los Baños and the Canadian International Agency for Development.

Resources Development Project. Not only will this material promote the general awareness on the basic concepts, principles, and guidelines but it will also enhance the technical capability for sustainable watershed management.

It is therefore vital that further studies on this environmental concern be conducted because as Cruz says, in general, watershed management in the Philippines is sectoral in nature. Consequently, many policies often overlap and lose their efficacy in disarray. This arose from the many different uses of watershed areas through the years. Many of these uses are often conflicting and competing for the limited watershed resources. As a result, various watersheds or water-related sectors all trying to protect their own interests emerged. The lack of an integrated framework has compounded and continues to aggravate the disintegration of watershed management in the country.<sup>10</sup>

The need for such an integrated framework or strategic approach is underscored further when the problem of the mismanaged watersheds is linked to the UNEP's (2004) Environmental Vulnerability Index (EVI) which includes 50 indicators of vulnerability/resilience divided into five major categories: weather and climate; geology; geography; resources and services; and human populations.

## **1.2 Statement of the Problem**

The study discusses the current state of the environment, impacts and vulnerability risks, leading to the development of sustainable development strategies

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<sup>10</sup> Cruz, R. V. O. (1997). Watershed management in the Philippines: a vital concern crying for integration. *Philippine Forestry Policy Forum* 3(1):1-5

to manage and conserve selected watersheds on the island of Mindanao in the Philippines.

Specifically, below are the problems that the study seeks to answer:

- a. What is the status of the problem area in terms of:
  - a.1. Geographical features of the country and its watersheds;
  - a.2. State of environment of the area;
  - a.3. State of watershed management; and
  - a.4. Environmental vulnerability risks?
- b. What is the impact of low productivity coupled with high population growth?
- c. What are the climate change impacts?
- d. What are the government agencies and laws to manage water resources?
- e. Strategies and methodologies to sustainably manage and conserve the watersheds? and
- f. What is watershed management through the strategic approach?

Proper watershed management results in the sustainable use of natural resources, the preservation of biodiversity, and the mitigation of the effects of natural disasters and climate change. To determine if there is proper management in the selected watersheds, this study will draw a picture of the state of the environment, its vulnerability, and the risks and impacts obtaining in the area.

After drawing a comprehensive picture of this situation and the serendipitous validation provided by a large magnitude natural disaster that recently occurred in the study area, the researcher will set forth a strategic approach to manage and conserve watersheds, taking into consideration the different laws and policies and other strategies already attempted, which will lead to sustainable development efforts in the management and protection of these watersheds.

Mismanagement ranges from utter neglect or complete lack of management all the way to actual ruinous practices that harm the watershed. The only way to reverse this is through a long-term, sustainable effort that will unite all watershed stakeholders in a strategic approach that will meet their competing needs and diverse interests. Essential to this is the idea that proper management comes from correct planning. In the case of watersheds, the basis of management planning should be the watershed as an entire unit, and not political or administrative boundaries.

Watershed mismanagement in the Philippines has many dire consequences. The most obvious are the biophysical effects of forest denudation, severe diminution of water resources and the loss of habitats and biodiversity. Sometimes less obvious but just as strong are the effects on humans: food security problems, poverty and economic hardship, increased vulnerability to natural hazards resulting in multiple deaths and injuries, and community displacement. Thus, this research discusses the current state of environment, management, impacts and vulnerability risks; and seeks to formulate and set forth a strategic approach to properly manage and conserve selected watersheds in Bukidnon and Lanao del Sur in Mindanao.

### 1.3 Setting of the Study

This research focuses on selected watersheds in the provinces of Bukidnon and Lanao del Norte in the north-central part of Mindanao island in the Philippines. The study was conducted over a 5-year period, May 2015 – May 2020. The surveyed sites in Bukidnon and Lanao del Sur number six zones, each of which is a cluster of critical watersheds comprising some 138,000 hectares of remaining mossy and secondary forests that need to be protected.

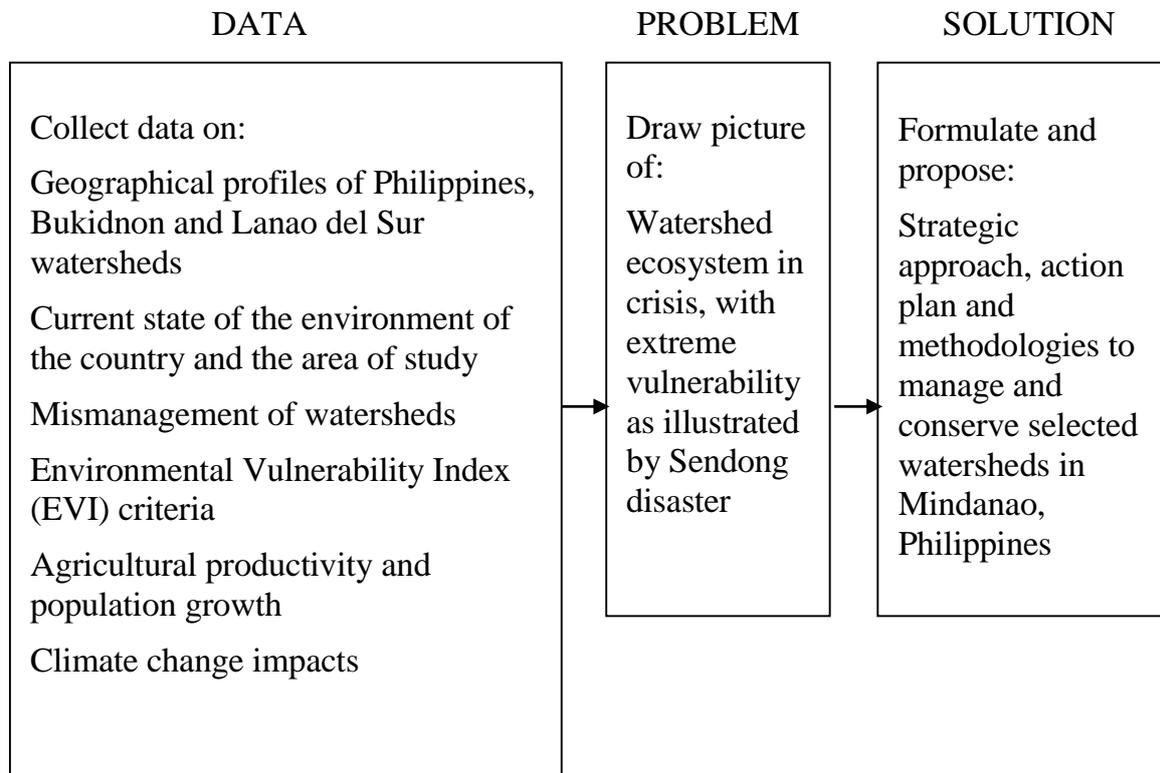
The geographical survey was done by applying methodologies that use agroforestry techniques and geographic information system (GIS) technology, as well as by working with local communities such as the indigenous peoples of Bukidnon, the Maranao of Lanao del Sur and migrant settlers in both provinces.

#### Research Schedule and Time Allocation

PERIOD	ACTIVITY
June 2015 - June 2017	Background information collection, interactions with local, regional and national authorities, and planning and design of study.
July 2017 – September 2019	Collection of bulk of data - completion of aerial and land surveys, collection of aerial photography and remote sensing maps; consultations and presentation of materials to senior government and non-government officials and other stakeholders.
October 2019 – March 2020	Completion of analyses of findings and recommendations of the study.
May - June 2020	Submission of draft of the study to the University; revision of the study based on Evaluation Panel's advice and comments.
July 2020	Defense and finalization of the study.

## 1.4 Conceptual Framework

The conceptual framework of this study may be represented by the following paradigm:



This descriptive study falls under the category of qualitative research. It draws information from diverse material and sources in an attempt to shed light on issues and understand phenomena. These material and sources include unstructured interviews and consultations; periodical, scholarly and corporate publications; maps; photographs; audio recording and direct participant experience and observation. Qualitative research attempts not only to answer “how” but also “why” through a holistic description of trends that will help identify possible solutions to a particular set of problems.

Calderon and Gonzales (1993) say that “Descriptive research,” such as this study, “reveals problems or abnormal conditions so that remedial measures may be instituted. It reveals to us what we do not want, what we want, and how to acquire what we want.”<sup>11</sup> Going by this definition of descriptive research, this study accumulated data from primary and secondary sources in order to clearly see and reveal the magnitude and gravity of the problem. Once the problem was identified and understood, a proposed integrated solution was set forth.

The conceptual framework paradigm graphically describes this step by step process as well as the content of each part of this process: from data gathered to description of problem to proposed solution.

### **1.5 Scope and Limitation of the Study**

This research is limited to the identification, discussion and presentation of the geographic features of the selected watersheds in Bukidnon and Lanao del Sur, their state of environment, management, impacts and vulnerability risks, levels of vulnerability risks of the area and the environmental, social and economic impacts of such vulnerability risks, presenting the different government agencies and policies in effect to manage water resources, and the formulation thereof of a strategic approach to manage and conserve the aforementioned watersheds in Mindanao, Philippines.

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<sup>11</sup> Calderon, J. F. and Gonzales, E. C. (1993). *Methods of Research and Thesis Writing*. National Book Store, Mandaluyong City. p. 63.

## **1.6 Significance of the Study**

This research will greatly contribute to the environmental, social and economic future of the Philippines especially in Mindanao. This study is important in the formulation of sustainable development efforts in managing and conserving the watersheds.

Students, policymakers, government officials engaged in the management and conservation of watersheds will benefit from this research as the world races to arrest the impending tragedies associated with global warming, water quantity and quality problems and climate change, arising in large part because of watershed mismanagement.

Community dwellers, business organizations and other stakeholders in the area will be the direct beneficiaries and their involvement will greatly affect the success of the management and conservation of the watersheds.

This research will hopefully contribute to the arresting of the degradation of watersheds not only of Mindanao, Philippines but also those of other countries facing a similar watershed ecosystem crisis situation.

## **1.7 Definition of Terms**

### **Conservation**

Preservation, protection, or restoration of the natural environment, natural ecosystems, vegetation, and wildlife.

**Ecological footprint**

A measure of human demand on the Earth's ecosystems. It is a standardized measure of demand for natural capital that may be contrasted with the planet's ecological capacity to regenerate. It represents the amount of biologically productive land and sea area necessary to supply the resources a human population consumes, and to mitigate associated waste. Using this assessment, it is possible to estimate how much of the Earth (or how many planet Earths) it would take to support humanity if everybody followed a given lifestyle. For 2006, humanity's total ecological footprint was estimated at 1.4 planet Earths – in other words, humanity uses ecological services 1.4 times as fast as Earth can renew them. Every year, this number is recalculated – with a three-year lag due to the time it takes for the UN to collect and publish all the underlying statistics.

**El Niño phenomenon**

An irregularly recurring flow of unusually warm water on the surface of the Pacific Ocean along the west coast of South America. It prevents the rise of nutrient-rich cold water from the ocean's depths and disrupts typical global weather patterns, resulting in extended dry periods.

**Environmental degradation**

Erosion of the quality of natural environment caused, directly or indirectly, by human activities. The deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable.

**Environmental vulnerability**

Environmental vulnerability is a function of intensity, and any expressions of it need to reflect this. In any consideration of the effects of a hazard on the condition and function of the natural environment, it is necessary to take into consideration, the area over which the effects of the hazard are to be absorbed or attenuated. For example, in terms of damage to the environment, 10 liters of oil will do more damage as pollution on one square meter of land than it would if it were distributed over one square kilometer. On the smaller plot of land, local ecological communities of organisms are likely to be overwhelmed by the influx of such a relatively large amount of pollution, and shifts in ecosystem quality and function may be expected.

**Environmental resilience**

The capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly. Such perturbations and disturbances can include stochastic events such as fires, flooding, windstorms, insect population explosions, and human activities such as deforestation and the introduction of exotic plant or animal species. Disturbances of sufficient magnitude or duration can profoundly affect an ecosystem and may force an ecosystem to reach a threshold beyond which a different regime of processes and structures predominates. Human activities that adversely affect ecosystem resilience such as reduction of biodiversity, exploitation of natural resources, pollution, land-use, and anthropogenic climate change and are increasingly causing regime shifts in ecosystems, often to less desirable and degraded conditions. Interdisciplinary discourse on resilience now includes consideration of the interactions of humans

and ecosystems via socio-ecological systems, and the need for shift from the maximum sustainable yield paradigm to environmental management which aims to build ecological resilience through "resilience analysis, adaptive resource management, and adaptive governance."

### **Environmental risk**

The chance that human health or the environment will suffer harm as the result of the presence of environmental hazards.

### **Environmental Vulnerability Index (EVI) indicators**

Environmental vulnerability has been characterized by three components or sub-indices. These sub-indices focus on ecosystem integrity and how it is threatened by anthropogenic and natural hazards. To be able to capture the complexity of these aspects of environmental vulnerability requires the development of a variety of indicators that target different spatial and temporal scales and hierarchical levels of the ecosystem. International initiatives to measure environmental condition or change range have developed anywhere from four to 260 indicators with increasing numbers being used to assess sustainable development progress or state of environment.

The EVI utilizes 50 'smart indicators' to capture the key elements of environmental vulnerability. The term 'smart indicators' has been used to define EVI indicators which aim to capture a large number of elements in a complex interactive system while simultaneously showing how the value obtained relates to some ideal condition. The basic assumption of smart indicators is that the value of a

chosen indicator is a culmination of perhaps millions of transactions that must have been operating appropriately to result in the value obtained. This does not require our full knowledge of every transaction because if this were a requirement, we would never be able to use indicators at all. Put simply, it's a bit like measuring our body temperature as an indicator of our health. If we have a high temperature it is a symptom of a potential health problem and we then rely on further tests and our doctor's experience to find out what may be wrong. Indicators, like temperature in this case, do not tell us exactly what is wrong but are a helpful gauge that identifies a potential problem that requires further investigation.

The indicators selected for use in the EVI are based on the best scientific understanding currently available and have been developed in consultation with international experts, country experts, other agencies and interest groups. Some important environmental vulnerability issues are not yet measured because relevant data or robust measurement techniques are not yet available. However with new technological advances especially in the area of remote sensing further indicators may be developed for use in the EVI. The refinement of indicators and search for more appropriate smart indicators is ongoing.

### **Hazards/Natural hazard**

A threat of a naturally occurring event that will have a negative effect on people or the environment. Many natural hazards are interrelated, e.g., earthquakes can cause tsunamis and drought can lead directly to famine.

### **Hazardous events**

Hazardous events are those that can lead to loss of diversity, extent, quality and function of ecosystems. These changes are often described as damage to the biological integrity (Karr, 1991) or health of ecosystems, and therefore their ability to keep supporting humans.<sup>12</sup> These may include natural hazards as well as human pressures. Vulnerability to damage arises from a combination of the inherent characteristics of a country, the forces of nature and human use, including the special case of climate change.

### **Human or Manmade disasters**

These are disasters resulting from manmade hazards (threats having an element of human intent, negligence, or error; or involving a failure of a manmade system), as opposed to natural disasters resulting from natural hazards. Manmade hazards or disasters are sometimes referred to as anthropogenic.

### **La Niña phenomenon**

An irregularly recurring rise of unusually cold water from the depths of the Pacific Ocean along the west coast of South America. It often follows an El Niño event and disrupts typical global weather patterns, resulting in extended wet periods.

### **Protected area**

National Integrated Protected Areas System (NIPAS) Act of 1992 defines a protected area to be “identified portions of land and water set aside by reasons of

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<sup>12</sup> Karr, J. R. (1991). Biological Integrity: A Long-Neglected Aspect of Water Resource Management. *Ecological Applications*. Vol. 1 No. 1. Retrieved from <http://www.jstor.org/discover/10.2307/>

their unique physical and biological significance, managed to enhance biological diversity and protected against destructive human exploitation.”

### **River basin**

The portion of land drained by a river and its tributaries. It encompasses the entire land surface dissected and drained by many streams and creeks that flow downhill into one another, and eventually into one river. The final destination is an estuary or an ocean.

### **Sustainable development**

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come (sometimes taught as ELF -- Environment, Local people, Future). The term was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. As early as the 1970s "sustainability" was employed to describe an economy "in equilibrium with basic ecological support systems." Ecologists have pointed to the limits to growth, and presented the alternative of a "steady state economy" in order to address environmental concerns.

The field of sustainable development can be conceptually broken into three constituent parts: environmental sustainability, economic sustainability and sociopolitical sustainability.

### **Vulnerability assessment**

An analysis of the relationship between natural and anthropogenic hazards and recipient subject (watershed). It identifies the strength and weaknesses of the recipient subject in relation to the identified hazard.

### **Watershed**

A land area drained by a stream or fixed body of water and its tributaries having a common outlet for surface runoff. It includes small watersheds with an area of 10,000 hectares (ha) and less; medium-scale exceeding 10,000 hectares up to 50,000 hectares; and large-scale exceeding 50,000 hectares in area.

### **Watershed characterization**

The process of describing the biophysical and socioeconomic characteristics and features of a watershed to have an understanding of the various processes within it.

### **Watershed condition**

Quantifies disturbances (stressors) the watersheds are subjected to; vulnerability denotes parameters at risk that could be changed (positive or negative) as a result of management activities.

**Watershed functions**

Ecological services performed by a healthy watershed, including maintenance of water flow regimes to benefit aquatic resources, groundwater recharge, municipal water supply, or other uses; and maintaining or restoring ecological conditions needed for ecosystem and species diversity.

## CHAPTER II

### REVIEW OF RELATED LITERATURE

#### 2.1 Foreign Literature

The United States Environmental Protection Agency (US EPA) defines a watershed as “the area of land where all of the water that is under it or drains off of it and goes into the same place. John Wesley Powell, scientist geographer, put it best when he said that a watershed is ‘that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.’”<sup>13</sup>

The Lane Council of Government (cited in US EPA, 2011) further illustrates that a watershed is a diverse inclusion of a hydrologic cycle from precipitation to percolation with the following essential geographical parts: tributaries, mountain ridges, sub-basins, lakes, agricultural lands, riparian zones, forests, towns, wetlands, watershed divides, and on to groundwater (aquifers).

What happens upstream (in a watershed) will influence everyone who lives downstream, says Kent Swanson. Further, he noted that we can prioritize watersheds for restoration those that are at risk, and focus on preserving watersheds that are already healthy.

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<sup>13</sup> EPA United States Environmental Protection Agency, (2011, September 29). What is a watershed? Retrieved from <http://water.epa.gov/type/watersheds/whatis.cfm>.

Conservation Ontario (2001) recommends that the protection of drinking water sources should be recognized as a permanent and integral part of a long-term, secure water supply strategy and that the watershed should be recognized as the viable unit for managing water.<sup>14</sup>

Watershed management is not so much about managing natural resources, but managing human activity as it affects these resources. The drainage area of the river provides the natural boundary for managing and mitigating human and environmental interactions. Because human activity includes actions by governments, municipalities, industries, and landowners, watershed management must be a cooperative effort. Effective watershed management can prevent community water shortages, poor water quality, flooding and erosion, Conservation Ontario continues.

In the most general terms, watershed management is important for the improvement and maintenance of good water quality in our watershed. In recent years, water quality standards have come under stress due to increasing population, diminishing water resources, and bad management practices.<sup>15</sup>

The importance of the watershed as a part of our resiliency is answered by a project report by the Asian Development Bank: Why should communities and nations cooperate in environmental protection and conservation?

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<sup>14</sup> Conservation Ontario (2001). Protect Water. Retrieved from [conservation-ontario.on.ca/source\\_protection/](http://conservation-ontario.on.ca/source_protection/)

<sup>15</sup> University of Florida IFAS Extension(2007, November 20). Watershed Management FAQs.*CSREES Florida Water Quality Program*. Retrieved from [waterquality.ifas.ufl.edu/FAQs-watershed.htm](http://waterquality.ifas.ufl.edu/FAQs-watershed.htm)

Malik and Ramachandran (2009),<sup>16</sup> who wrote the above-mentioned project report, believe that first and foremost, the reason for cooperation among local communities as well as nations is self-interest – i.e., the goal of cooperation is to improve livelihood, quality of life, the economy and competitiveness within the community. As interdependence and connectivity among societies and economies intensify, these self-interests tend to converge, developing into common interests. This then provides an incentive for communities and countries to cooperate. Regional and global trade pacts are one manifestation of this trend. Similarly, food, energy and water security concerns are resulting in partnerships between and among countries. In short, economic imperatives are, and will continue to be, at the heart of this trend in increased cooperation across countries and regions.

Clearly, such cooperation and partnering must be further strengthened if the countries of the Greater Mekong Sub-region (GMS) are to achieve sustainable development in the region without leaving behind any section of the global community. (GMS is a contiguous geographic mass, with the Mekong River passing through six upstream and downstream countries of the Mekong River.) In addition, these partnership efforts must focus on the region's natural resources and environment; how well the GMS takes care of its environmental infrastructure – air, land, forests, and water – will determine the success and sustainability of current and future economic development plans.

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<sup>16</sup> Malik, U. S. and Ramachandran, S. (2009). Mainstreaming Environmental Sustainability in Development Planning The Case of the Greater Mekong Sub-Region. In Sato, J. (Ed.). *Transboundary Resources and Environment in Southeast Asia*. University of Tokyo.

The collective performance on the environmental front will also help to avoid potential conflicts over natural resources such as energy and water. Undoubtedly, the quality of the environment will be the key differentiator between successful and unsuccessful communities or countries. As ecosystems and environmental problems cut across political boundaries, cooperation among stakeholders and among countries is essential.

The Illinois Watershed Management Clearinghouse (IWMC) declares that watersheds are important as the viability of the watershed directly affects the health of the communities within that watershed.<sup>17</sup> Water for human consumption, wildlife, industry and recreation are all impacted by activities that occur within the watershed.<sup>18</sup>

### **Types of watershed**

Watersheds are classified depending upon their size, drainage, shape and land use pattern:

1. Macro watershed (> 50,000 hectares)
2. Sub-watershed (10,000 to 50,000 hectares)
3. Milli-watershed (1,000 to 10,000 hectares)
4. Micro watershed (100 to 1,000 hectares)
5. Mini watershed (1-100 hectares)

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<sup>17</sup> Illinois Watershed Management Clearinghouse, (n.d.). Why Watershed Management Matters. Retrieved from [http://www.watershed.uiuc.edu/getting\\_involved/index.cfm](http://www.watershed.uiuc.edu/getting_involved/index.cfm)

<sup>18</sup> TNAU Agritech Portal, (n.d.). Watershed Management. Retrieved from [http://agritech.tnau.ac.in/agriculture/agri\\_majorareas\\_watershed\\_watershed\\_mgt.html](http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershed_mgt.html)

## **Objectives of watershed management**

The different objectives of watershed management programs are:

1. To control damaging runoff and degradation and thereby conservation of soil and water.
2. To manage and utilize the runoff water for useful purpose.
3. To protect, conserve and improve the land of the watershed for more efficient and sustained production.
4. To protect and enhance the water resource originating in the watershed.
5. To check soil erosion and to reduce the effect of sediment yield on the watershed.
6. To rehabilitate the deteriorating lands.
7. To moderate the floods' peaks at downstream areas.
8. To increase infiltration of rainwater.
9. To improve and increase the production of timbers, fodder and wild life resource.
10. To enhance the ground water recharge, wherever applicable.

## **Factors affecting watershed management**

1. Watershed characteristics
  - i) Size and shape
  - ii) Topography
  - iii) Soils
  - iv) Relief
2. Climatic characteristics

- i) Precipitation
  - ii) Amount and intensity of rainfall
3. Watershed operation
  4. Land use pattern
    - i) Vegetative cover
    - ii) Density
  - e) Social status of inhabitants
  - f) Water resources and their capabilities.

### **Watershed management practices**

In terms of purpose:

1. To increase infiltration
2. To increase water-holding capacity
3. To prevent soil erosion

In brief, various control measures are:

1. Vegetative measures (Agronomical measures)
  - a. Strip cropping
  - b. Pasture cropping
  - c. Grass land farming
  - d. Wood lands
2. Engineering measures (Structural practices)
  - a. Contour bundling
  - b. Terracing
  - c. Construction of earthen embankment

- d. Construction of check dams
- e. Construction of farm ponds
- f. Construction of diversion
- g. Gully controlling structure
  - 1. Rock dam
  - 2. Establishment of permanent grass and vegetation
- h. Providing vegetative and stone barriers
- i. Construction of silt tanks detention

In addition, the influence of soil conservation measures and vegetation cover on erosion, runoff and nutrient loss are important factors that need to be borne in mind when considering strategies for watershed management and conservation. In this regard, the choice of methodologies adopted to ensure regeneration of ground vegetation cover and the protection of soil cover, and minimize the chances of grass fires becomes critical for ensuring longer-term sustainability of mossy mountain forests which are often also the watershed areas in many countries of Southeast Asia including the Philippines.

Watershed planning and management is important, IWMC reiterates, because growth and development from communities are stressing water resources. Community-based watershed management helps reduce flood damage, decreases the loss of green space, reduces soil erosion and improves water quality. Watershed management planning works to protect water resources by empowering local people to provide for the environmental, social, and economic health of the community.

Yusuf and Francisco (2009) illustrate the climate hazard map of Southeast Asia including the Philippines and lists cyclones, landslides, floods and droughts as its dominant hazards. Among the areas in the Philippines which are classified as having the highest vulnerabilities are: National Capital Region, Southern Tagalog, Cagayan Valley, Central Luzon, the Cordillera Administrative Region and Bicol Province, with the National Capital Region particularly ranking as the most likely vulnerable to multiple climate hazards because of high density population. NCR is the seventh most vulnerable among the provinces/districts in all of Southeast Asia.<sup>19</sup>

A recent related development in the management and conservation of watersheds which should be considered a part of the environment assessment phase is the introduction and use of the Environment Vulnerability Index (EVI).<sup>20</sup> The EVI measures hazards, damage and resistance levels of particular countries to various risk factors.

Developed under the auspices of the United Nations Environment Programme (UNEP) and several donor countries, the Philippines is one of the collaborating countries in the creation and formulation of the EVI, along with Bangladesh, Barbados, Botswana, Costa Rica, Greece, Jamaica, Kenya, Kyrgyz Republic, Malta, Mauritius, Nepal, St. Lucia, Singapore, Thailand and Trinidad.

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<sup>19</sup> Yusuf, A. A. and Francisco, H. (2009). *Climate Change Vulnerability Mapping for Southeast Asia*. Singapore: Economy and Environment Program for Southeast Asia. p. 13.

<sup>20</sup> SOPAC and UNEP, (2005). *Environmental Vulnerability Index*. Retrieved from [www.vulnerabilityindex.net/EVI/background.htm](http://www.vulnerabilityindex.net/EVI/background.htm)

The EVI utilizes 50 ‘smart indicators’ to capture the key elements of environmental vulnerability. The term ‘smart indicators’ has been used to define EVI indicators which aim to capture a large number of elements in a complex interactive system while simultaneously showing how the value obtained relates to some ideal condition. The basic assumption of smart indicators is that the value of a chosen indicator is a culmination of perhaps millions of transactions that must have been operating appropriately to result in the value obtained. Thankfully, this does not require our full knowledge of every transaction because if this were a requirement, we would never be able to use indicators at all. Simply it’s a bit like measuring our body temperature as an indicator of our health. If we have a high temperature, it is a symptom of a potential health problem and we then rely on further tests and our doctor’s experience to find out what may be wrong. Indicators, like temperature in this case, do not tell us exactly what is wrong but are a helpful gauge that identifies a potential problem that requires further investigation.

## **2.2 Foreign Studies**

Wagner et al’s (2002) multiple case study findings suggest that “global freshwater resources are being increasingly polluted and depleted, threatening sustainable development and human and ecosystem health.”<sup>21</sup>

“Utilizing case studies from four different watersheds in the United States, Japan, Switzerland, and Brazil, this paper identifies the most relevant sustainability deficits and derives general vectors for more sustainable water management. As a

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<sup>21</sup>Wagner, W. et al. (2002). Sustainable Watershed Management: An International Multi-Watershed Case Study. *JSTOR*. Retrieved from [www.jstor.org/pss/4315203](http://www.jstor.org/pss/4315203)

consequence of the demographic and economic developments experienced in the last few decades, each watershed has suffered declines in water quality, stream flow and biotic resources. However, the extent and the cultural perception of these water-related problems vary substantially in the different watersheds, leading to specific water-management strategies.

“In industrialized countries, such as the US, Switzerland, and Japan, these strategies have primarily consisted of finance- and energy-intensive technologies, allowing these countries to provide for their water requirements while minimizing human health risks. But, from a sustainability point of view, such strategies, with limited natural resources, are not long-term solutions.

“For newly industrialized countries such as Brazil, expensive technologies for water management are often not affordable, thus limiting the extent to which newly industrialized and developing countries can use the expertise offered by the industrialized world. Sustainable water management has to be attained through a common learning process involving industrialized, newly industrialized, and developing countries, following general sustainability guidelines as discussed in this paper.”

Kusek (2000) researched on the effects of successful watershed management and his study describes “a soil erosion control project that is being carried out in East Anatolia, Turkey, above some of the country’s largest dams:

Keban, Karakaya, and Ataturk on the Euphrates River.<sup>22</sup> The project is partly financed by the World Bank and has been underway since 1992. The main goal is to reduce soil erosion and resulting sedimentation of dams and to improve the economic condition of people living in the region. The project is coordinated by the Ministry of Forestry and includes the Ministry of Agriculture and the Ministry of Rural Service. The project covers the main basin of the Euphrates River and is divided into three segments: the lower, middle and upper basins. The upper basin is generally in the region of Elazig and is directly around the Keban dam; the middle and lower basins are in the regions of Malatya and Adiyaman, respectively. The Middle basin is near the Karakaya dam while the lower basin is around Ataturk dam. The initial project included 18 sub-basins and 54 micro-catchments with an average area of 5,000 hectares.”

Shoaib (2000), in his research on watershed management and operations management in Bangladesh concluded that shifting cultivation is the major agricultural activity in hilly areas of Bangladesh.<sup>23</sup>

The following are excerpts from Shoaib’s research abstract: Shifting cultivators themselves realize that shifting cultivation is not a sustainable method nowadays because of decrease in productivity due to the shortening of the shifting cultivation cycle.

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<sup>22</sup> Kusek, G. (2000). Effects of Local People on the Success of the Watershed Rehabilitation Projects. *American Society of Civil Engineers*. Retrieved from [ascelibrary.org/proceedings/resource/2/ascecp/105/40499/77\\_1](http://ascelibrary.org/proceedings/resource/2/ascecp/105/40499/77_1)

<sup>23</sup> Shoaib, J. U. (2000). Participatory Micro Watershed Development for Hill Dwellers in Bangladesh: A Challenge. *American Society of Civil Engineers*. Retrieved from [ascelibrary.org/proceedings/resource/2/ascecp/105/40499/78\\_1](http://ascelibrary.org/proceedings/resource/2/ascecp/105/40499/78_1)

It was estimated that about 32,500 ha/yr are used for shifting cultivation in Bangladesh. Soil loss...was estimated at about 1.5 million t/yr. With the development of communication, marketing facilities, education and health care, etc., a change of lifestyle was observed among the *jhumias* (shifting cultivators) as they were exposed to a new aspiration. The *jhumias* are very slowly transforming their lifestyle near township, road network and/or market facilities. Building nurseries, producing valued fruit crops, working as daily labor, both male and female *jhumias* join the transplanting of rice in the valleys.

Taking into account the aspiration of the people as well as the biophysical condition of the area, (the project staff) started to work with *jhumia* families to develop a participatory micro watershed for a better land husbandry system. In this approach, *jhumia* families and (project) scientists are working on the same land, learning from each other and introducing better land use on sloping land for conserving soil and making farming sustainable for the family. The approach will lead the farmer to be in a permanent farming system as well as benefit from conservation measures such as contour planting, gully control, choosing crops, which are the crucial problems for transferring technology in watershed management.

## **2.3 Local Literature**

### **Geography and Population of the Philippines**

The Philippines is a tropical country consisting of more than 7,000 islands. It is one of the largest island groups in the world covering a total area of 300,000 square kilometers (km<sup>2</sup>), 92% of which is accounted for by the 11 largest islands.

The archipelago is bounded by the West Philippine Sea (South China Sea) in the west, by the Philippines Sea (Pacific Ocean) in the east, by the Sulu Sea and Celebes Sea in the south and by the Bashi Channel in the north. Its northernmost islands are approximately 240 kilometers (km) south of the island of Taiwan, and the southernmost islands lie 24 km off the coast of Borneo (Malaysia). Of the country's more than 7,000 islands, only 3,144 are named. There are also thousands of small islets grouped with the larger islands.

The Philippines is divided into three major island groups: Luzon, with an area of 142,000 km<sup>2</sup>; Visayas, with an area of 56,000 km<sup>2</sup>; and Mindanao, with an area of 102,000 km<sup>2</sup>. These three groups are further divided into regions, provinces, cities, and municipalities, which are further divided into barangays. In 1996, the country had 12 regions plus three specific regions, namely Metropolitan Manila (National Capital Region), the Cordillera Administrative Region, and the Autonomous Region of Muslim Mindanao. There are 76 provinces, 60 cities, 1,544 municipalities, and 41,921 barangays.<sup>24</sup>

The Philippines has a varied topography with highlands and numerous valleys. Its four major lowland plains are the central plain and the Cagayan valley in Luzon, the Agusan valley and the Cotabato valley in Mindanao. These lowlands contrast sharply with the adjacent high mountain areas of the central and east Cordilleras and the Zambales mountains. The highest peaks reach almost 3,000 meters (m) above sea level at less than 30 km from the sea.

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<sup>24</sup> *The Encyclopedia of Earth*. (n.d.). Retrieved from [www.eoearth.org/article/water\\_profile\\_of\\_Philippines](http://www.eoearth.org/article/water_profile_of_Philippines)

The total cultivated area is estimated at 9.5 million hectares (ha), of which 56% is for annual crops. The average farm size is 2.2 ha.

In 1996, the total population was estimated at 69.28 million (45% rural). The average population density is 231 inhabitants/km<sup>2</sup>, ranging from 46.9 inhabitants/km<sup>2</sup> in Agusan del Sur (Region X, Northern Mindanao) to 348 inhabitants/km<sup>2</sup> in Region IV, Southern Tagalog, a region in Luzon south of Manila, and more than 13,000 inhabitants/km<sup>2</sup> in Metropolitan Manila. The average annual population growth is estimated at 2.4%.

Agriculture is the prime mover of the country's economy, being at present the least import-dependent activity. From 1988 to 1990, the agriculture sector's contribution to Gross National Product (GNP) varied around 17%. It provided about 30% of Gross Domestic Product (GDP) and generated more than 60% of total export earnings. It employed about 41.5% of the labor force in 1996.<sup>25</sup>

### **Climate and Water Resources**

The climate of the country is tropical and monsoonal. It is characterized by uniformity of temperature (average temperature of 27°C throughout the year), high relative humidity (above 70% everywhere throughout the year except in southern Tagalog where it falls to 65% in March/April), low solar radiation, diversity of rainfall and high frequency of tropical cyclones. The main air streams that affect the Philippines are the northeast monsoon from late October to March, the southwest monsoon from May to October and the North Pacific trade winds,

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<sup>25</sup> Ibid.

dominant during April and early May. Many of the larger islands of the Philippines have high mountain ranges, most of which lie along a generally north-south axis across the paths of movement of the important air streams. Thus, apart from temperature effects due to elevation, the aerographic effects of mountains have important influences on regional rainfall patterns by causing increased precipitation on windward slopes and rain shadows in their lee during the monsoon periods.

The average annual rainfall is estimated at 2,373 millimeters per year (mm/year) as observed from 1961-1990, but this figure varies from 961 mm (General Santos City in southeast Mindanao) to more than 4,051 mm (Infanta in central Luzon). The extreme annual rainfall events ever recorded are 94 mm at Vigan in Ilocos Sur (northern Luzon) in 1948 and 9,006 mm in Baguio City (northern Luzon) in 1910.

The rainfall pattern and annual amount are influenced mainly by altitude and wind. The northwest of the country has a dry season from November to April and a wet season during the rest of the year, i.e. the southwest monsoon. The southeast receives rainfall all year round, but with a pronounced maximum from November to January during the northeast monsoon. In the areas not directly exposed to the winds, rainfall is evenly distributed throughout the year, or there are two seasons but not very pronounced; from November to April the weather is relatively dry while it is relatively wet the rest of the year. The lowest rainfall occurs in the provinces of Cebu, Bohol, and Cotabato in the center of the country.

The archipelago lies in the typhoon belt, and many islands are liable to extensive flooding and damage during the typhoon season from June to December. The frequency of typhoons is greater in the northern portion of the archipelago than in the south. Usually, 20 typhoons reach the country each year.

### **River Basins and Water Resources**

There are 421 rivers in the country, not counting small mountain streams that sometimes swell to three times their size during rainy months. The rivers are an important means of transportation and a valuable source of water for irrigation for the fields and farms through which they pass. There are also 59 natural lakes and more than 100,000 ha of freshwater swamps.

The five principal river basins (more than 5,000 km<sup>2</sup>) are: the Cagayan River basin in north Luzon (25,469 km<sup>2</sup>); the Mindanao River basin (23,169 km<sup>2</sup>) in Mindanao island; the Agusan River basin (10,921 km<sup>2</sup>) in Mindanao island; the Pampanga River basin (9,759 km<sup>2</sup>) near Manila in Luzon island; and the Agno River basin (5,952 km<sup>2</sup>) in Luzon island. Only 18 river basins have an area greater than 1,000 km<sup>2</sup>: eight of them are in Mindanao island, seven in Luzon island, two in Panay island, and one in Negros island. The smallest river basins are frequently under 50 km<sup>2</sup>.

In order to have manageable units for comprehensive planning of water resources, the National Water Resources Board (NWRB) divided the country into 12 water resources regions. Major considerations taken into account in this regionalization were the hydrological boundaries defined by physiographic

features and homogeneity in climate of the different parts of the country. However, in fact, these water resources regions generally correspond to the existing political regions in the country. Minor deviations dictated basically by hydrography affected only northern Luzon and northern Mindanao.

The country's annual average runoff is estimated at 444 km<sup>3</sup>. In nine years out of 10, the annual runoff exceeds 257 km<sup>3</sup>.

### **Groundwater Resources**

There are four major groundwater reservoirs (Cagayan, 10,000 km<sup>2</sup>; Central Luzon, 9,000 km<sup>2</sup>; Agusan, 8,500 km<sup>2</sup>; Cotabato, 6,000 km<sup>2</sup>) which, when combined with smaller reservoirs already identified, would aggregate to an area of about 50,000 km<sup>2</sup>.

Private wells are extensively used in rural areas for domestic purposes. Municipal waterworks wells are drilled by the Local Water Utilities Administration for domestic purposes and deep wells have been drilled by the National Irrigation Administration (NIA) for irrigation purposes.

The groundwater resources are estimated at 180 km<sup>3</sup>/year, of which 80% (145 km<sup>3</sup>/year) would constitute the base flow of the river systems. The total internal water resources would therefore amount to 479 km<sup>3</sup>/year.

### **Dams**

The total dam capacity in 1995 was 4,753 million m<sup>3</sup>, consisting of about 54 small dams (for a total capacity of 80 million m<sup>3</sup>) and six large dams. In the

Philippines, a dam is considered large when the storage capacity exceeds 50 million m<sup>3</sup> and the structural height is more than 30 m. Three of the large dams are managed by the National Power Corporation (NPC) (Angat, Ambuklao, and Palangi IV for a total capacity of 1,426 million m<sup>3</sup>), the two largest dams being managed by the NIA (Magat River Integrated Irrigation System (MRIIS) and Pantabangan-Upper Pampanga River Integrated Irrigation System (UPRIIS) for a total capacity of 3,196 million m<sup>3</sup>). One large dam (La Mesa, 51 million m<sup>3</sup>) is managed by the Metropolitan Waterworks and Sewerage System, which is also responsible for the management of a small dam (Ipo, 36 million m<sup>3</sup>). The NPC is also in charge of three small dams (Agus II, IV and V for a total capacity of 27.7 million m<sup>3</sup>) while all other small dams have been created with various objectives within the framework of the small water impounding management (SWIM) projects, which are implemented by several agencies.

A survey of surface water storage potential has identified sites for 438 major dams and 423 smaller dams.<sup>26</sup>

### **State of Watersheds**

The state of Philippine watersheds can be found in the Department of Environment and Natural Resources web site, [denr.gov.ph](http://denr.gov.ph) in its 2001 publication *Philippines Forestry Statistics*, and the Main Report of the *Global Forest Assessment 2000*, which was also published by the FAO in 2001. Forestlands,

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<sup>26</sup> Ibid.

according to the report, covered 15,885 million ha or 53% of the country and the remaining 47% of the land area is classified as alienable and disposable lands.

Of the 15.885 million ha of forestlands, 14.766 million ha have been identified as forest reserves of some type. This includes some 3.273 million ha of established timberlands and some 10.228 million ha of national parks, game reserves and bird sanctuaries. There are also 125 watershed forest reserves which cover an aggregate area of 1.499 million ha. However, some 7% of officially designated forestlands (1.089 million ha) are still unclassified.<sup>27</sup>

The DENR report confirms that deforestation is continuing at a rate of 89,000 ha per year or 1.4% of the national forest area annually. In comparison, the annual deforestation rates in Thailand, Indonesia and Malaysia reported by FAO are 0.7%, 1.2% and 1.2% per annum respectively.

Tongson (2009) states that enforcement (in the activities within the watershed area) is weak due to lack of personnel and equipment, corruption, slow prosecution of cases and lack of political will and that the underlying causes of deforestation are upland poverty, high population growth, lack of property rights and poor governance.<sup>28</sup>

Hineleban Foundation (2010) describes the area of study: “In the heart of Mindanao lies Bukidnon. From Bukidnon emanates the arteries that sustain much of

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<sup>27</sup>Forest Management Bureau, (n.d).2001 Philippine Forestry Statistics. Retrieved from forestry.denr.gov.ph/stat2001.htm

<sup>28</sup> Tongson, E. E. (2009). Introduction. *Ilagan Watershed Reports*. Retrieved from [http://wwf.org.ph/wwf3/downloads/publications/Ilagan\\_Watershed\\_Reports\\_OIntroduction.pdf](http://wwf.org.ph/wwf3/downloads/publications/Ilagan_Watershed_Reports_OIntroduction.pdf) p. 2

life on the island. These arteries are the six river systems that flow through neighboring provinces and empty into four bays to the north and south of the island.

“But these arteries are in trouble. Forest denudation has caused Bukidnon’s watersheds to lose the ability to attract and hold water. What happens downstream is everyone’s nightmare – flooding, siltation, aridity, loss of power generation, and all of their attendant problems – loss of productivity, loss of livelihood, mass migration to urban areas that are themselves strained to their limits, poverty, hunger, discontent, land conflicts, and the exacerbation of festering secessionist and insurgency movements. The situation is worsened by the imminent and growing threat of climate change,” Hineleban Foundation continues.<sup>29</sup>

“There was a time when Mindanao, the southernmost and second biggest landmass in the Philippines, was covered with lush tropical forests thriving with wildlife, and traversed by rivers teeming with marine life. The land was very fertile, the air was clean, food was bountiful, and there was a seemingly unlimited reserve of natural resources. People, plants and animals lived together and nurtured one another in a healthy ecosystem.

“Today, however, only a small portion of the original forest cover remains. Massive logging, kaingin (slash-and-burn agriculture), and wild grass fires have, over the years, killed millions of trees and left large areas of the mountains bare. Many of the region’s vital watersheds have been destroyed, resulting in the drying up of rivers, thus depriving farms of year-round irrigation, siltation of lakes and seas

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<sup>29</sup> Hineleban Foundation , Inc. (2010). *Mindanao Rainforestation*. Bukidnon, Philippines. p. 1.

causing death to coral reefs, and flash floods during the rainy season damaging people's homes and livelihood. Hence, despite the vast tracts of land around them, many people in Mindanao are poor and hungry – they are among the poorest and hungriest people in the Philippines.

“Bleak as Mindanao’s environmental situation may be, it is still better than in many other parts of the country. With vast areas of land still untapped for agricultural production, a population still less dense than in highly populated Luzon, and a climate that is still typhoon-free for most of the year, Mindanao presents great potential for development. It commands bright promise for becoming the Philippines’ next food basket, and supplying an even bigger part of the country’s food requirements than the 40% it is contributing today.”<sup>30</sup>

### **Broader Socio-Economic and Environmental Impacts in Mindanao**

Malik (2010) suggests that the success or failure of nations in their pursuit for economic development depends, among other factors, on nurturing racial harmony and peaceful coexistence, as well as on the manner by which they manage the environment and use natural resources. Continued conflict among people, overexploitation of resources and poor environmental governance undermines any attempt for sustainable development and erodes the prospects for economic growth and poverty reduction.<sup>31</sup>

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<sup>30</sup> Ibid. p. 3.

<sup>31</sup> Malik, U. S. (2010, August 8). Mindanao can be RP food basket. *Philippine Daily Inquirer*. p. A14.

Long-term peace and stability is, therefore, closely linked to pursuing a socially responsible and environmentally sustainable path to development. Safety and security for people in the workplace and the availability of reliable land, water, food and energy are essential ingredients for eradicating poverty, raising living standards and ensuring human dignity for all.

Today, the Philippines is not only unable to grow enough food to feed its current population of over 100 million but yet each year, it continues to add another two million more mouths to feed. At the same time, our ability to produce food is steadily declining. Luzon, which has been the traditional rice granary of the Philippines, is now beset with unpredictable weather patterns that have become the normal annual pattern: too much rain and flooding with typhoons, and extended dry seasons without enough rainfall or irrigation water to sustain crop production.

There are many other reasons also as to why we are facing food shortage, some of which were also touched upon by President Noynoy Aquino in his first State of the Nation Address (SONA). Governance in our institutions is weak and there continue to be allegations of mismanagement in rice imports and distribution system. Security of land tenure for our farmers remains an issue with much remaining to be done through the agrarian reform process. Much of land is being converted in to real estate and property leaving less available land for agriculture and crop production. And, farmer training and extension services need improvement.

Another important reason for the emerging food crisis has to do with loss of forest cover. As a result of massive logging and slash and burn practices, as well as natural fires, our primary forest cover has declined from over 70% in the 1970s to less than 3% today. Forests are a vital source for regulating our climate and help provide the rainfall needed for our agriculture. They are also important to absorb the carbon in the atmosphere, thereby helping mitigate against the dangers of global warming and climate change.

As a result of the aforementioned factors, today we have a rather serious food situation in the country. We import on average about 1.5 to 2 million tons of rice annually and have a hunger rate of 20%. Unless serious efforts are made to reverse these trends, the hunger rate could rise to as much as 30% in just the next decade due to rising population growth, which is estimated to reach nearly 120 million by the year 2025.

A key issue we face is the future of the culturally-unique and resource-rich island of Mindanao. Peace in Mindanao is critical not just for ensuring safety and security for all in the Philippines as well as in Asia-Pacific region, the island is also vital for our food security.

However, despite numerous attempts to bring about peace and development, Mindanao remains one of the poorest islands in the country. Internal and external conflicts and all out wars over many decades have claimed the lives of far too many people, and continuously aggravated poverty and despair on the island.

Such instability has disrupted agricultural production, destroyed economic infrastructure, affected the social fabric of society, displaced thousands of people from their homes, and deterred the much needed investment.

We must find an appropriate solution for Mindanao through deepened dialogue with our Muslim brothers and sisters. Engaging the enlightened leadership of Mindanao and finding young champions who truly believe in promoting racial harmony and social stability would be essential for inclusive and equitable development, and for ensuring that the dividends of peace are sustainable over the long term.

Undoubtedly, the prospects for a peaceful co-existence are greater when partnerships with local communities and tribal leaders are strengthened, more economic opportunities are provided to the masses to reduce poverty, and there is enough food on the table to feed all members of the family.

The island of Mindanao is fortunate not to have extended dry seasons as we witness today in Luzon and has the water resources to support 2-3 crops a year – it can be, as it has often been called, the “food basket” of the Philippines. Mindanao’s highly fertile soils account for bountiful harvests of a variety of farm products: It grows most of the Philippines' major crops such as rubber (100% of national production), pineapple and cacao (90%), as well as banana, coffee, corn and coconut (over 50%).

Taken together, these crops account for over 40% of the Philippines' food requirements. The island economy also contributes more than 30% to the national

food trade making agriculture the driving force for the island's socioeconomic development.

However, while Mindanao does not suffer the unpredictability of the northern typhoon belt, it does face its own challenges. As noted earlier, as with the rest of the country, slash and burn farming and illegal logging in Mindanao have caused the loss of mountain forests that produce rainfall for the plains and rivers and provide safe water for drinking, irrigation and hydroelectric power generation downstream.

Such is the extent of the damage that in rivers such as the Agusan and Kumaykay the water discharge (estimated in liters per second) has decreased by up to 75%, and the Pulangi Hydroelectric Power station operates at about 50% of its capacity, thus impacting on food production and energy supply for the island and the country as a whole.

If this trend is not reversed, the Philippines will have lost its only viable food basket, and we will be facing a starving mass population.

We must, therefore, tackle this issue through an aggressive campaign for reforestation and watershed management in the pristine natural environments of Mindanao. Principally, these areas include the six mountain ranges that are the haven for primary mossy forests and the critical watersheds which are located in the heart of Mindanao, especially Bukidnon and parts of Lanao del Sur, including one of the largest water reservoir on the island – Lake Lanao.

Specifically, the primary mossy forests and their associated watershed zones need to be protected include, the Pantaron, Kitanglad, Kalatungan, Matigsalug, and Wao and Bumbaran mountain ranges. These watersheds feed six major river systems, namely, Cagayan, Tagoloan, Pulangi, Maridugao, Davao-Salug, and Gingoog.

Saving the mossy forest would ensure adequate supply of water, food and energy while at the same time help improve the livelihood of people, thereby increasing the prospects for peace and equitable development in Mindanao.

Alongside, we must also develop the large available fertile agricultural lands downstream of the large river systems of Mindanao, with extensive water supply systems and rural irrigation networks, post harvest facilities and farm to market roads. To do this, we must also encourage private investment and public-private partnerships, and build a coalition with like-minded thinkers from the academe and nongovernmental organizations to enable a strong bottom up consultative approach to community driven development.

The main areas to focus for agriculture development include South and North Cotabato, Sultan Kudarat, southern Bukidnon – and most especially, the two largest undeveloped areas – Maguindanao and Lanao Del Sur, which are an integral part of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM).

The people of Mindanao are fed up with long years of conflict and war. They want to live in peace and dignity, earning a decent livelihood. They want

their children to be educated and have a healthy, productive life. The best weapons against poverty, social disharmony and despair are peace and sustainable development.

### **Government Policies and Institutions in Water Management**

The National NWRB coordinates the activities of the different agencies involved in the water sector (irrigation, hydropower, flood control, navigation, pollution, water supply, waste disposal, watershed management, etc.).

The other main agencies involved in water resources management and their specific areas of concern are listed below.

#### ***Water supply and wastewater***

- The Metropolitan Waterworks and Sewerage System (MWSS) of the Department of Public Works and Highways (DPWH), is responsible for water supply, storage, treatment, research, design, construction, and maintenance of water supply and sewage systems in the national capital region and outlying service areas in nearby provinces:
- The Local Water Utilities Administration (LWUA) of the Department of Public Works and Highways (DPWH), which is responsible for the development and improvement of water and sewerage systems in areas not covered by the MWSS.

#### ***Water resources monitoring and development***

- The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), which conducts monitoring, data gathering, and maintenance of information on rainfall and evaporation;
- The Bureau of Research and Standards (BRS) of the DPWH, which is engaged in monitoring and studies of water resources as well as water research and quality standards. The DPWH is also responsible for flood control;
- The NPC, which conducts water resources monitoring, research and hydropower generation.

### *Irrigation*

- The NIA of the Department of Agriculture, which was created in 1974 with the mandate to initiate an irrigation age. Its tasks include the development, operation, and maintenance of irrigation systems throughout the country. In particular, it has been responsible for the construction of NIS schemes, and is now responsible for the recovery of irrigation fees.
- The Bureau of Soils and Water Management (BSWM) of the Department of Agriculture, which handles, through its Project Management Office (PMO), the construction and maintenance of SWIM projects.

The SWIM projects have been implemented by the Government to mitigate damage brought about by insufficient water supply during the dry season and the frequent floods during the rainy season. The objectives might differ from one

project to another, and the following agencies are involved: the DPWH, for water supply, inland fishing and mini-hydropower; the NIA, for irrigation; the Forest Management Bureau (FMB), for watershed management with an incidental purpose of flood control; and the National Electrification Administration (NEA), for mini-hydropower generation.

The 1976 Water Code of the Philippines revised and consolidated the laws governing the ownership, appropriation, utilization, exploitation, development, conservation, and protection of water resources which are subject to government control and regulation through the NWRB.

A list of current Philippine laws and regulations governing watershed management is in Appendix A.

## **CHAPTER III**

### **RESEARCH METHODOLOGY**

#### **3.1 Research Design**

This is a descriptive study that drew data from published and online sources, particularly technical studies, reports and presentations; unstructured interviews, consultations and meetings with various stakeholders, including national and local government officials, legislators, scientists, farmers, environmentalists, nongovernment and peoples' organizations, tribal leaders and indigenous people; and a geographic information system that was used to take an actual aerial and land survey, validated by field visits, observation and photographic documentation. Data gathering was done over a 5-year period, from May 2015 to May 2020.

The series of consultations with stakeholders included, among others, local government leadership (governors, vice governors and mayors), of Bukidnon and Lanao del Sur, presentations to Sangguniang Panlalawigan (Provincial Board) and Sangguniang Bayan (City Board), and to the Regional Development Council for Region X, military and police of Bukidnon, senators and congressmen from Mindanao, officials from the DENR, PAMB, and others departments and agencies concerned with forest, land and watersheds, the academic community from Bukidnon and Los Baños, selected private sector companies who draw their water from the watersheds of the chosen sites, and the forest communities living within Bukidnon and Lanao del Sur (Table 1 below is referred).

**Table 1.** Key Senior Officials and Experts Consulted and Interviewed

OFFICIAL/EXPERT	AGENCY/POSITION
Sec. Proceso Alcala	DA Secretary
Sec. Gil de los Reyes	DAR Secretary
Gov. Alex Calingasan	Bukidnon provincial government
22 Mayors of Bukidnon	Bukidnon city and municipal governments.
Vice Gov. Jose Zubiri, Jr.	Bukidnon provincial governments
Bukidnon Sangguniang Panlalawigan	Bukidnon provincial governments.
Region 10 Regional Development Council	Various departments and agencies in Region 10
Sen. Teofisto Guingona III	Senate/Senator from Bukidnon
Sec. Ramon Paje	DENR Secretary
Rep. Jose Zubiri III	House of Representatives 3 <sup>rd</sup> District, Bukidnon
SEARCA, UPLB, IRRI	Academe
Rep. Jose Zubiri III	House of Representatives 3 <sup>rd</sup> District, Bukidnon
Rep. Rufus Rodriguez	House of Representatives 2 <sup>nd</sup> District, Cagayan de Oro
Rep. Jesus Paras	House of Representatives 1 <sup>st</sup> District, Bukidnon

Former Sen. Miguel Zubiri	Senate/Senator
DDG Rolly Tungpalan	NEDA
<i>Table 1 cont.</i>	
Asst. Sec. Marlon Mendoza	DENR
Dr. Emil Javier	Former UP President, UPLB Chancellor
Sen. Koko Pimentel	Senate/Senator

The aforementioned presentations and consultations with the personalities led to wide-ranging broad consensus on the strategic approach being proposed by this research. There was consensus that pilot sites used to test the rainforestation effort have clearly demonstrated the success and viability of the approach; the preparation of soils before planting or reforestation begins is vital for ensuring the sustainability of the effort over the long-term; the budget appropriated to the mountain rainforestation effort should take into account the difficult mountain terrain and denudation of the areas to be covered by the rainforestation program; the urgency to begin the rainforestation effort was underscored by a number of senior officials given the recent Sendong disaster and the crucial need to avoid such disasters in the future; and the vital need to have strong ownership and leadership by the provincial and municipal authorities as well as the communities themselves.

In addition, it was emphasized that there is ever more the chance to succeed in the rainforestation effort if the community based or nongovernmental organizations have strong and close relationships with the communities and have

their trust and confidence to undertake the task by entering into a partnership. Moreover, the need for transparency and accountability (good governance) in the use of funds and implementation of the reforestation program was underscored.

This researcher estimates that in addition to the above-named personalities and groups, about 2,000 other people have been consulted or were present during his various presentations at larger forums or symposiums (including, among others, such events as the National Corn Congress, seminars organized by the Management Association of the Philippines, Chambers of Commerce and Industry, and some think tanks in the country), as well as other consensus-building efforts on the research for developing the strategic approach in the upper river basins of selected watersheds in Bukidnon and Lanao del Sur.

In addition, his study also used the environmental assessment results culled from the Environmental Vulnerability Index developed by the United Nations Environment Programme (UNEP), which combines some 50 indicators to reflect the extent to which the natural environment of a country is prone to damage and degradation.

### **3.2 The Geographical Site and Survey**

#### **Method to determining state of environment**

The state of the environment at the selected sites was determined by processing land satellite images guided by a series of field observations, aerial photography, ground validation and secondary reports. Since the required images of

two watersheds were not available at the national mapping office, the researcher acquired them directly from foreign sources.

A team of GIS and forestry specialists implemented the image analysis and the ground verification. The classification process consisted of combined unsupervised classification and manual classification techniques. The analysis resulted in the determination of the state of the environment of the selected watersheds.

### **3.3 Data Gathering Tools**

3.3.1 Several local and international websites were accessed at various times before and during the study period, a list of which is included in the bibliography.

3.3.2 Books, reference materials, and lectures from different sources were also used in this study.

3.3.3 An actual aerial and land survey of the geographical site was done, pictures of which were taken and were used in this research.

3.3.4 The researcher conducted informal interviews with the technical and field officers of the Hineleban Foundation using an unstructured questionnaire.

3.3.5 Government, nongovernment organizations, and international agencies' data were also included in this study.

## CHAPTER IV

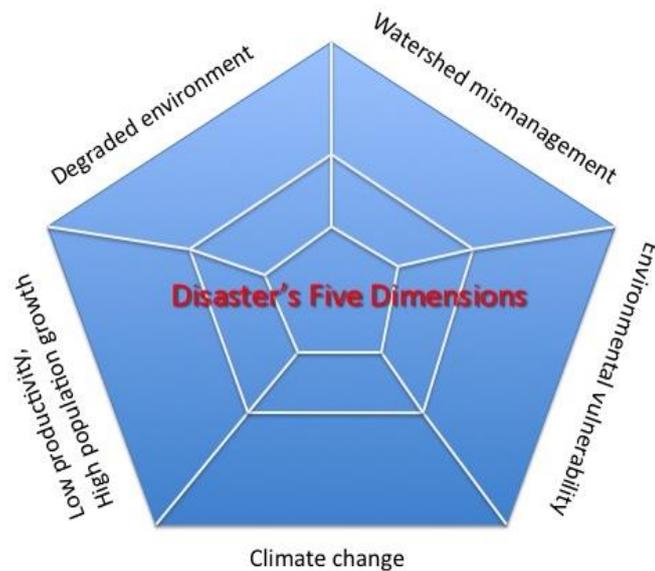
### PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

#### 4.1 Crisis and Disaster

The Philippine watershed ecosystem is in deep crisis. This extreme crisis situation may be represented as a complex web of interrelated sub-problems that has five major dimensions. Figure 1 below illustrates these five dimensions or problem areas that are closely linked and impact on each other and the crisis situation as a whole. This researcher seeks to portray the scope of the problem, with particular focus on watershed mismanagement, in order to formulate a strategic approach to properly manage and conserve selected watershed areas in Mindanao, Philippines.

The very recent Sendong disaster that unleashed an “inland tsunami” on the Northern Mindanao cities of Cagayan de Oro and Iligan dramatically illustrates these five dimensions: a highly degraded environment, watershed mismanagement, environmental vulnerability, low productivity coupled with high population growth, all exacerbated by climate change.

**Figure 1.** Five Dimensions of the Philippine Watershed Ecosystem in Crisis



Watershed mismanagement in the Philippines has many dire consequences. The most obvious are the biophysical effects of forest denudation, severe diminution of water resources and the loss of habitats and biodiversity. Sometimes less obvious but just as strong are the effects on humans: food security problems, poverty and economic hardship, increased vulnerability to natural hazards resulting in multiple deaths and injuries, and community displacement; thus, this research discusses the current state of environment, management, impacts and vulnerability risks, leading to the formulation of sustainable development strategies to properly manage and conserve selected watersheds in Bukidnon and Lanao del Sur in Mindanao.

Below are the sub-problems or issues that were answered or discussed by this research:

What is the status of the problem area in terms of:

4.2a. Geographical features of the country and its watersheds;

- 4.2b. State of environment of the area;
- 4.2c. State of watershed management; and
- 4.2d. Environmental vulnerability risks?
- 4.3. What is the impact of low productivity coupled with high population growth?
- 4.4. What are the climate change impacts?
- 4.5. What are the government agencies and laws to manage water resources; and
- 4.6. Strategies and methodologies to sustainably manage and conserve the watersheds?
- 4.7 What is watershed management through the strategic approach

#### **4.2a Geographical Features of the Area**

##### **Physical Profile of the Philippines and Mindanao**

Figure 2. Map of the Philippines



Figure 2 is the physical map of the Philippines.

The country's terrain is mountainous, with narrow coastal plains and relatively wider interior plains. There are 421 major rivers, numerous tributaries, 59 natural lakes and more than 100,000 hectares of freshwater swamps all over the country. The watersheds are directly on top of all these geographical attributes. There are four major groundwater reservoirs; these are in Cagayan Valley, Central Luzon, Agusan and Cotabato. Dams are distributed all over the country, consisting

of 54 small and six large dams. A recent survey of surface water storage potential has identified sites for 438 major dams and 423 smaller dams.

The Philippines had in 2000, a total of 15,885 million hectares or 53% of the country classified as forestlands, with the remaining 43% of land area classified as alienable and disposable lands.

The climate of the Philippines is tropical and monsoonal, with a consistent temperature of 27 degrees centigrade throughout the year, low solar radiation, diverse rainfall profile at 2,373 millimeters per year and high frequency of tropical cyclones. The country is located in a typhoon belt. Some of the archipelago's 7,107 islands and islets are submerged and disappear during typhoons or the rainy season.

The country has an aggregate area of approximately 50,000 km<sup>2</sup> of groundwater resources, with the major ones being Cagayan Valley – 10,000 km<sup>2</sup>; Central Luzon – 9,000 km<sup>2</sup>; Agusan – 8,500 km<sup>2</sup> and Cotabato – 6,000 km<sup>2</sup>.

The total domestic water resources of the Philippines are estimated at 479 km<sup>3</sup>, 80% or 145 km<sup>3</sup> of which are the base flow of the river systems.<sup>32</sup>

Mindanao has four big seas, namely Macajalar Bay, Gingoog Bay, Illana Bay, and Davao Gulf. The research area shown in Figure 3 below covers four major regions of Mindanao, namely: ARMM, Region 10, Region 11, and Region 12. In addition to Bukidnon, the research area impacts on five other provinces, namely: Misamis Oriental, Lanao del Sur, Davao del Norte, North Cotabato and

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<sup>32</sup> *The Encyclopedia of Earth*. (n.d.). Retrieved from [www.eoearth.org/article/water\\_profile\\_of\\_Philippines](http://www.eoearth.org/article/water_profile_of_Philippines)

Maguindanao (these are major food growing provinces) and four coastal cities: Davao City, Cotabato City, Cagayan de Oro City and Gingoog City (from where food crops are transported to other regions or islands of the country or overseas for export).

**Figure 3.** Physical Map of Mindanao



Source: Hineleban Foundation, Inc.

### Physical Profile of Bukidnon and Lanao del Sur

Bukidnon occupies a vital position in the geographical and ecological map of Mindanao. It is not only centrally located on the island; it is also where six of Mindanao's major rainforest watersheds are found. These are the mountain ranges

of Kitanglad, Mt. Kalatungan, Pantaron and Matigsalog, as well as Wao and Bumbaran in Lanao del Sur which are the rain shadow for southern Bukidnon. Figure 4 below shows that from these watersheds flow six great rivers that nourish the fertile valleys of Mindanao: Cagayan River, Tagoloan River, Pulangi River, Maridugao River, Davao-Salug River, and Gingoog River.

Raluto (2011) writes that “The watersheds of these rivers cover about 94% of Bukidnon’s total land area. For this reason, the whole territory of Bukidnon may be considered a ‘watershed’.”<sup>33</sup>

Within the province, there are some 182,000 hectares of primary and secondary forests and grasslands that are home to a wide variety of plant and animal species. Outside of these forests are vast fertile lands suitable for growing corn, rice, sugar, banana, pineapple and other crops.

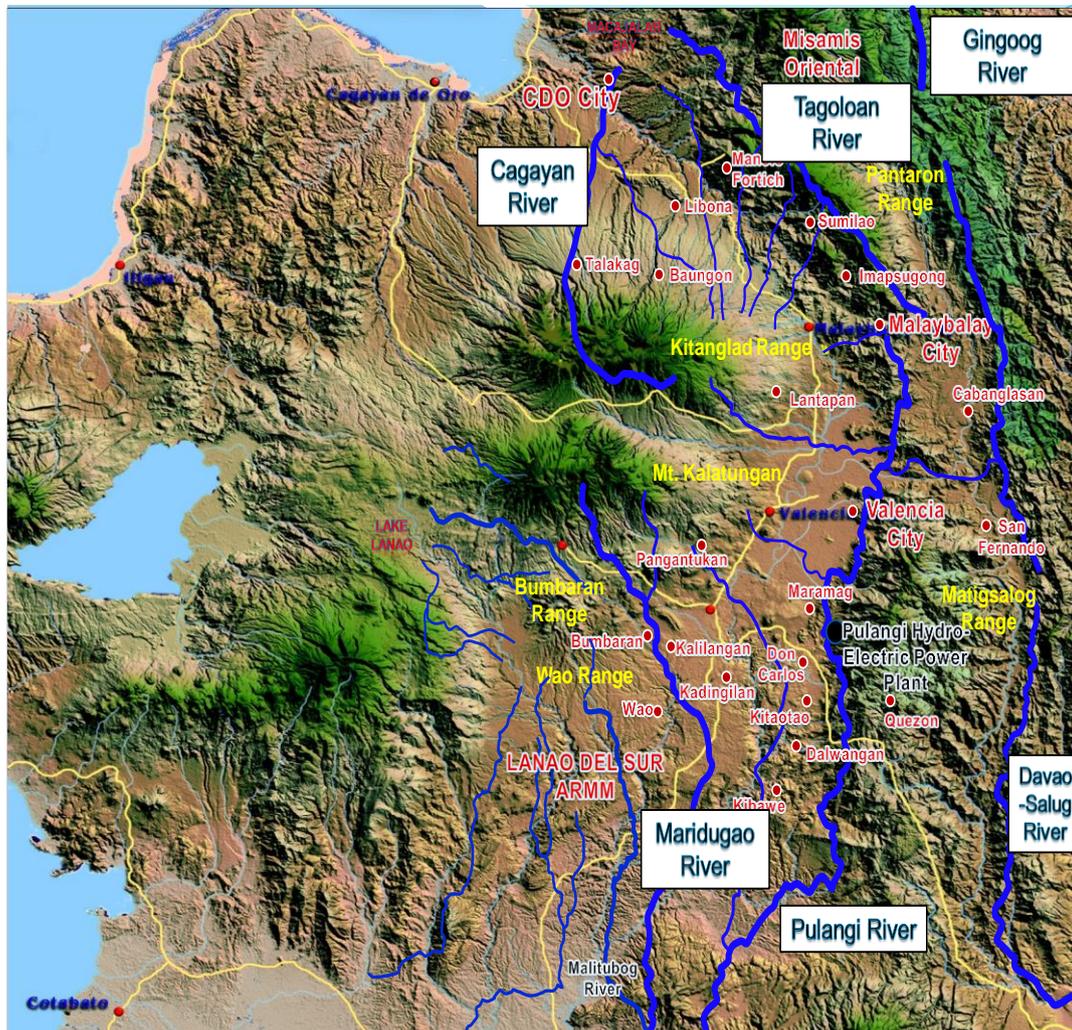
Bukidnon can be described as being in the heart of Mindanao, owing to its location in the north-central part of the island. It covers a territory of 10,499 square kilometers, making it the fourth largest province in the country. Bukidnon is also the most elevated province of the island, with most of its land area situated 500 meters above sea level. In fact it gets its name from the word “bukid,” which means “mountain.”

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<sup>33</sup> Raluto, R. D. (2011, December 31). The Sendong tragedy in Mindanao and the ecosystem services of the Bukidnon forests. *Mindaviews*. Retrieved December 2011, from <http://www.mindanews.com/mindaviews/2011/12/31/commentary>

Two of Mindanao's river basins are among the biggest five principal river basins in the Philippines: the Mindanao River basin (23,169 km<sup>2</sup>) and the Agusan River Basin (10,921 km<sup>2</sup>).

**Figure 4.** Physical Map of Bukidnon and Lanao del Sur



Source: Hineleban Foundation, Inc.

#### 4.2b 1<sup>st</sup> Dimension: Degraded State of the Environment

##### Erosion and siltation

Bukidnon's watersheds, like those in many parts of the country, are in various degrees of degradation characterized by soil erosion, erratic stream flow, diminishing groundwater resource and declining land productivity (Cruz, 1999).<sup>34</sup>

A case in point is the Pulangi river watershed, which is the main water source of Bukidnon and is the second largest watershed in the country with an area of about 1.8 million hectares. It is also known as the Upper Pulangi watershed which comprises 10 catchments that cover six municipalities and two cities in Bukidnon, namely: Impasugong, Cabanglasan, San Fernando, Lantapan, Maramag, Quezon, Valencia City and Malaybalay City. The watershed is the major source of water of the existing National Power Corporation (NPC)-Pulangi IV Hydroelectric Power Plant with a capacity of 255 megawatts located at Maramag. The plant contributes 25% of Mindanao's power needs. The watershed also provides for the National Irrigation Administration (NIA) dam which serves 8,000 hectares of rice paddies. It is a reservoir-type power plant with a surface area of about 1,985 hectares and a live storage of 67 million cubic meters. The catchment's forestland area is about 289,127 hectares, 60% or approximately 192,368 hectares of which is devoid of trees. Thus, a high degree of soil erosion in some parts of the sub-watershed is evident. The estimated volume of silt in the reservoir is 26 million cubic meters.

Like the Lake Lanao-Agus River watershed reservation, NPC is responsible for the management and development of 40,772 hectares within the immediate

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<sup>34</sup> Cruz, R. V. O. (1999). Integrated Land Use Planning and Sustainable Watershed Management. *Journal of Philippine Development*.47 (26). p. 30.

vicinity of the Pulangi IV Hydroelectric Power Plant. The whole reservation is under the administrative jurisdiction of the Department of Environment and Natural Resources.

**Figure 5.** Siltation of Dam and Lakes



Source: Google Maps

Figure 5 shows the extent of siltation at the Pulangi Dam. The reduced water depth of the dam has forced the hydroelectric power plant to operate at only about half its capacity.

Province-wide, according to Adornado and Yoshida (2010), “About 37% of the total land area of Bukidnon suffers from very high to very severe erosion.

Many farms in this area are located on slopes, therefore soil conservation measures and the use of suitable crops (are) recommended.”<sup>35</sup>

**Figure 6. Siltation in Coastal Areas**



The effects of erosion and siltation are felt far downstream. Silt that reaches the sea and settles down on the seabed degrades and kills coral reefs. This in turn leads to the loss of habitat of fish and other marine life, which then results in drastically reduced fish catch and economic hardship for fishermen and their families.

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<sup>35</sup> Adornado, H. A. and Yoshida, M. (2010). Assessing the Adverse Effects of Climate Change: A Case Study in the Philippines. *Journal of Developments in Sustainable Agriculture* 5: 141-146. Retrieved November 2011, from [www.jstage.jst.go.jp](http://www.jstage.jst.go.jp)

Nellemann, Hain and Alder (2008), editors for the United Nations

Environment Programme's *In Dead Water*, raise the alarm:

Marine pollution, more than 80% of which originates from land-based sources, is projected to increase, particularly in Southeast and East Asia, due to rising population and coastal development. Increased loads of sediments and nutrients from deforestation, sewage and river run-off will greatly diminish the resilience of coral reefs... These impacts will be further compounded by sea level rise and the increased frequency and intensity of storms that easily break down weakened or dead corals and are likely to severely damage beaches and coast lines.<sup>36</sup>

The economic impact is severe, considering that most fish are caught very close to the coast. According to Nellemann et al (2008):

The primary and most important fishing grounds in the World are found on and along continental shelves within less than 200 nautical miles of the shores. The distribution of these fishing grounds is patchy and very localized. Indeed more than half of the 2004 marine landings are caught within 100 km of the coast with depths generally less than 200 m covering an area of less than 7.5% of the world's oceans, and 92% in less than half of the total ocean area. These treasure vaults of marine food play a crucial role for coastal populations, livelihoods and the economy... Coral reefs support over a million animal and plant species and their economic value exceeds US\$30 billion a year.<sup>37</sup>

An ADB report in 2008 classifies 70% of Philippine corals at "high risk" and only 30% in good condition.<sup>38</sup>

## **Rainfall decline and flooding**

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<sup>36</sup>Nellemann, C., Hain, S. and Alder, J. (Eds.), (2008). *In Dead Water – Merging of climate change with pollution, over-harvest, and infestations in the world's fishing grounds*. United Nations Environment Programme, GRID-Arendal, Norway. Retrieved November 2011, from [www.unep.org/pdf/InDeadWater\\_LR.pdf](http://www.unep.org/pdf/InDeadWater_LR.pdf)

<sup>37</sup> Ibid.

<sup>38</sup> Asian Development Bank (2008). *Country Environmental Analysis*. Manila: Unpublished draft.

Such is the extent of the damage to the watersheds that in rivers such as the Agusan and Kumaykay in Bukidnon, the water discharge (estimated in liters per second) has decreased by up to 75% over the last 30 years. This loss of river water discharge during the dry season is compelling evidence of rainfall decline.

**Table 2.** Average Water Discharge, Dry Season, in Liters Per Second

Year	Agusan River	Kumaykay River
1955 to 1989	1,923.60	1,603
2001 to 2005	487.33	393.67

Source: NIA Region 10

**Figure 7.** Agusan River During Dry Season



Source: Hineleban Foundation, Inc

**Figure 8.** Kumaykay River During Dry Season



Source: Hineleban Foundation, Inc.

The Philippines is now experiencing the paradox of rainfall decline and flooding at the same time.

On the one hand, the country is suffering from chronic water shortages due to the denudation of forests which should bring the rains in the seasons when rain is needed the most. Without forests, the hydrological cycle is disrupted. Forests are essential to the maintenance of the hydrological cycle because forests attract warm clouds that form from ocean and seawater evaporation. These warm clouds form the condensation (which then falls as rain) when they strike against the cooler air that the forests provide.

On the other hand, forests also act as a buffer against flooding as they hold water during a heavy downpour. Denudation of forests thus leads to severe flooding and siltation downstream. Figures below show the impact of forest denudation, mismanagement of watersheds, lack of integrated water resource management planning or simply bad infrastructure development without regard to upstream-downstream impacts.

**Figure 9.** Flooding in Lowland Farm Communities



“Flooding commonly occurs in the Philippines during almost every heavy rain event. Along with the deluge of water come soil materials,” observed Adornado and Yoshida (2010).<sup>39</sup>

**Figure 10.** Flooding in Urban Areas



<sup>39</sup>Adornado, H. A. and Masao Yoshida, (2010). Assessing the Adverse Effects of Climate Change: A Case Study in the Philippines. *Journal of Developments in Sustainable Agriculture* 5: 141-146. Retrieved November 2011, from [www.jstage.jst.go.jp](http://www.jstage.jst.go.jp)

## Forest denudation

How did we lose our forests? The foremost reason is massive logging from the 1950s up to the 1980s. Despite a ban on log exports and a continuing campaign against illegal logging since the 1990s, the Philippines still lost 3,412,000 hectares of forest from 1990 to 2005.<sup>40</sup>

**Figure 11.** Result of Massive Logging



*Denuded mountains stretching to the horizon.*

Source: Hineleban Foundation, Inc.

Logging in the Philippines was done on such a massive scale and so fast a pace it stripped the country of its forest cover in less than 40 years, going from 53% forest cover in the 1950s to just over 2% forest cover now.

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<sup>40</sup>*Philippines: Environmental Profile.* (n.d.). Retrieved November 2011, from <http://rainforests.mongabay.com/20philippines.htm>

Despite efforts at reforestation, figures from the Forest Management Bureau show that deforestation far outpaces any and all reforestation programs that have been initiated. Figure 12 below shows this most graphically.

**Figure 12. Rates of Deforestation and Reforestation**



Source: Forest Management Bureau

An ADB assessment of DENR's Forestry Sector Program (FSP) in the 1990s reports that "Over the FSP period, the area of forest continued to decline at an alarming rate. The loss of natural forest over the period 1987 to 1998 was 818,000 ha based on an analysis of DENR statistics. In the private sector, there is

concern that illegal logging has shifted from natural forests to plantation forests in areas where security is difficult to enforce.”<sup>41</sup>

**Figure 13.** Slash and Burn Farming Methodology



Source: Hineleban Foundation, Inc.

Kaingin or slash and burn farming is a long-practiced farming method where trees are cut and the vegetation is burned to prepare the soil for planting. The ash helps fertilize the land, which is productive for two to three years, after which the kaingineros move on to a new area to slash and burn, in a continuing

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<sup>41</sup> Asian Development Bank (2001 December). *Program Performance Audit Report on the Forestry Sector Program (Loans 889[SF]/890-PHI) in the Philippines*, p. 22.

cycle of destruction. Productivity is low, with kaingineros and their families harvesting just enough to subsist on. The practice may be sustainable, as long as population pressure and density are low and the fallow period is extended. This is not the case in the Philippines, however, which has a rapidly growing population, and kaingin is right next to logging and grass fires on the high forest destruction scale. The DENR Forest Management Bureau recorded 7,300 hectares of forest lost due to kaingin in 2007 alone.

**Figure 14.** Grass Fires in Forests



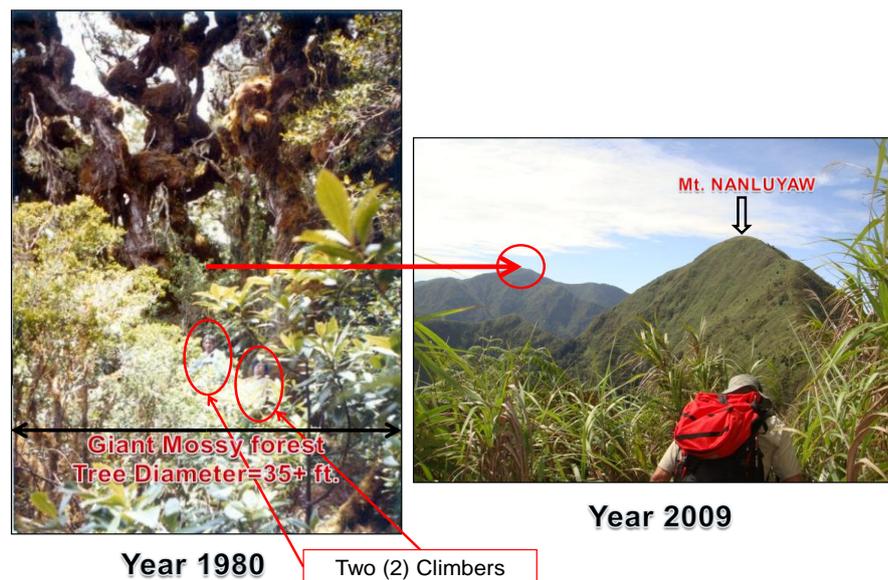
Source: Hineleban Foundation, Inc.

Where the trees have been cut, cogon and talahib soon take over. These wild grasses are highly combustible, and any spark or ember could ignite them. What is worse is that when these wild grass fires happen in ravines and gullies, a

“chimney effect” is created, and trees on the upper slopes and ridges are also burned. About 6,000 hectares of forest are affected by fires every year.<sup>42</sup>

Cogon grass (*Imperata cylindrica*) is a particularly pernicious weed that prolifically self-propagates through tough rhizomes that grow as long as 1.5 to 3 meters a year or through thousands of seeds that travel long distances on wind currents. “Cogon grass is considered one of the 10 worst weeds worldwide and a pest in 73 countries. It can invade and overtake disturbed ecosystems, forming a dense mat of thatch and leaves that make it difficult for other plants to coexist. Large infestations of cogon grass can alter the normal fire regime of a fire-driven ecosystem by causing more frequent and intense fires that injure or destroy native plants.”<sup>43</sup>

**Figure 15. Comparative Record of Tree Cover**



Source: Hineleban Foundation, Inc.

<sup>42</sup>Philippines: *Environmental Profile*. (n.d.). Retrieved November 2011, from <http://rainforests.mongabay.com/20philippines.htm>.

<sup>43</sup>Trugalman, Lothar (2011). Internal memorandum to chair of Unifrutti Services, Inc. Dr. Trugalman is research head of Unifrutti.

#### **4.2c 2<sup>nd</sup> Dimension: State of Watershed Management**

Watershed management in the Philippines is a microcosm of the country's major ills: fragmented; disorganized; unfunded; hostage to competing vested interests and corruption, weak central government direction and control, confused and conflicting legislation, and local government neglect.

The following discussion on the issue of watershed mismanagement was culled from a feasibility study co-authored by this researcher for the Integrated Natural Resources and Environment Management project when he was still with the Asian Development Bank (2009).<sup>44</sup>

#### **Consequences of watershed mismanagement**

The watersheds in the upper river basins of the Philippines occupy almost 50% of the total land area and provide critical environmental services such as flood protection, maintenance of waterflow regimes to benefit aquatic resources, maintaining or restoring ecological conditions needed for ecosystem and species diversity, and carbon sink against global warming. Well-managed watersheds also support socioeconomic development by serving as a source of livelihood for millions, especially for indigenous peoples (IPs) who constitute about 30% of the population in the study area. Watershed integrity determines the state of the delivery of ecosystem services and the consequent benefits thereof, not only for the local inhabitants but also the downstream residents and investors, and the global community.

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<sup>44</sup> Asian Development Bank,(2009).*Feasibility Study Republic of the Philippines Integrated Natural Resources and Environmental Management Project*. Manila: Unpublished study.

Many of the watersheds today are in varying states of degradation characterized by soil erosion, erratic stream flow, diminishing groundwater resource, loss of biodiversity, microclimate deterioration, and declining land productivity.

Soil erosion is considered to be the worst problem, with estimates of between 74 to 81 million tons of soil being lost annually, and between 63% and 77% of the country's total land area affected.

Watershed degradation in the Philippines is attributed to a wide range of physical and socioeconomic factors, but in reality is a complex, often localized issue. The causes of degradation are discussed below:

## **1. Natural Hazards**

The major natural hazards in the Philippines, i.e., biophysical conditions which act as predisposing factors for watershed degradation are:

### ***1.a. Hazards for water quantity and quality***

- Monsoonal climate patterns result in seasonal variations in rainfall, i.e., the risk of too much rainwater at some times of the year and too little at other times;
- Natural climatic cycles, such as the periodic El Niño and La Niña phenomena, mean that years of lower or higher than average rainfall can be expected on a periodic basis;

- Floods following periods of heavy and prolonged rainfall (e.g., during the passage of an intense slow-moving tropical cyclone/typhoon event) are a natural hazard, even in areas of excellent forest cover; and
- Many rivers already contain considerable volumes of sediment (from past severe storm events) in transit along the river system, hence control of erosion upstream will have little short- and medium-term effects on their sediment discharge.

***1.b. Hazards for soil erosion by water***

- Monsoonal rains with high intensity storms;
- Steep slopes of the mountain and hill lands;
- Geological instability associated with recently formed (in geological terms) hill and mountain landscapes, such as the Sierra Madre and Mt. Pinatubo, exacerbated by periodic earthquake and volcanic activity; and
- Soils with low resistance to water erosion (e.g., volcanic ash, silty soils, top soils low in organic matter).

***1.c. Hazards for soil fertility decline***

- Strong leaching associated with the country's generally high rainfall;
- Soils which are strongly acid, and/or with low natural fertility;
- Rapid decay and mineralization of soil organic matter due to the country's warm tropical climate;
- Much of the nutrients in tropical humid forest ecosystems are stored in the vegetation rather than the soil, hence the soils in many deforested areas are naturally low in fertility.

## **2. Direct Causes of Watershed Degradation**

Various types of human activity can be identified as direct causes of watershed degradation such as the following:

### ***2.a. Deforestation and removal of natural vegetation***

This is defined as the near complete removal of natural vegetation from large stretches of land by converting forest into agricultural land, road construction and urban development. Deforestation leads to loss of wildlife habitats, micro-climate changes, and loss of production potential from a range of wood and nonwood renewable resources, and potentially to erosion and loss of nutrients.

### ***2.b. Overexploitation of vegetation for domestic use and commercial sale***

Contrary to “deforestation and removal of natural vegetation,” this does not involve the (near) complete removal of the “natural” vegetation, but rather a degeneration of the remaining vegetation. This can result to insufficient protection against erosion, as well as loss of production potential and ecosystem degradation. Included are activities such as uncontrolled logging, and excessive gathering of fuelwood, poles, rattan, nuts, fruits, vines and fodder.

### ***2.c. Inappropriate agricultural activities***

These activities refer to the improper management of cultivated arable land. It includes a wide variety of practices, such as absence or poor maintenance of erosion control measures, improper crop rotations, shortening of the fallow period in kaingin cultivation, insufficient or excessive use of fertilizers, and overuse of irrigation water. This category would also include the extension of cultivation

onto lands of lower potential and/or high hazards (e.g., steep slopes). Degradation types commonly linked to this causative factor are soil erosion, soil compaction, soil nutrient loss, and water pollution (by sediment, pesticides, and fertilizers).

#### ***2.d. Inappropriate forestry activities***

These activities refer to the improper management of natural forests and tree plantations. This includes a variety of poor forest management practices such as the use of destructive timber harvesting technologies, badly constructed logging roads, and inappropriate plantation establishment (e.g., removal of ground cover by burning/clean weeding, planting in lines up and down the slope). This category would also include the replacement of a mixed natural forest with plantations of a very limited range of exotic species. Degradation types commonly linked to this causative factor are soil erosion and downstream sedimentation, soil nutrients loss, loss of biodiversity/wildlife habitats.

#### ***2.e. Overgrazing***

Besides overgrazing of grassland areas, excessive livestock population trample the surface soil and vegetation. The effect is usually soil compaction and/or a decrease of plant cover, both of which may, in turn give rise to soil erosion and reduced infiltration of rainwater.

#### ***2.f. Poor water resource management***

In some parts of the Philippines, the over extraction of water (for irrigation, urban and industrial use) from rivers and other surface water sources has led to reduced downstream availability. Where water is returned after use, it may have a

higher salt content and/or be polluted from agro/industrial-chemicals and human wastes. Inefficient irrigation practices, wasteful urban/industrial water use and leakages from water delivery systems all contribute to water shortage problems, as does over-pumping of the aquifers. In many lower watershed areas, the intensive use of tube wells has led to extraction of water in excess of natural recharge of rainfall and river seepage and a progressive lowering of the water table. In coastal areas, over-extraction of groundwater has resulted in salt water intrusion into the freshwater aquifer (a growing problem in parts of Cebu).

### ***2.g. Unregulated land conversion***

Uncontrolled land development for agricultural, residential, commercial and/or industrial purposes may contribute to degradation should such land uses or the management practices followed be unsuitable. Farm households affected by the conversion of agricultural lands to commercial, industrial, residential, and recreational (golf courses) purposes may be forced to seek land elsewhere, which in the land scarcity situation prevailing in the Philippines usually means moving into marginal upland areas. Hence, unregulated urban and industrial expansion within lowland agricultural areas may be contributory to watershed degradation elsewhere.

### ***2.h. Industrial activities***

Include all human activities of a (bio)industrial nature such as the following: timber processing, factory farming (e.g., large-scale commercial poultry and piggery farms), power generation, mining, infrastructure and urbanization, waste handling, etc. It is most often linked to pollution of different

kinds (either point source or non-point). In addition to possible chemical and organic pollutants, uncontrolled rainwater run-off from mine spoil heaps, unconsolidated roadside cuttings and embankments, urban and industrial sites can be the source of significant quantities of downstream sediment.

### **3. Indirect Causes of Watershed Degradation**

Indirect causes of watershed degradation are the underlying reasons why inappropriate types of land use and management are practiced and usually relate to the socio-economic circumstances of the land users and/or the social, cultural, economic and policy environment in which they operate:

#### ***3.a. Population growth and movement into the uplands***

In many uplands areas there is a steadily expanding population from both the natural growth of the indigenous population and inward migration from the lowlands. This leads to increasing pressure on a finite, and often ecologically vulnerable, natural resource base. The problem is exacerbated where population growth is taking place at the same time as the natural resource base on which it depends is shrinking, i.e., where land degradation has already reduced the productivity of the arable, pasture and forest areas within individual watersheds.

#### ***3.b. Population growth and development in the lowlands***

A growing population in the lowlands with its needs for increased urbanization and industrial development leads to an ever-expanding demand for

water, electricity, timber, agricultural crops, recreation facilities, may lead to over-exploitation of watershed resources in the uplands.

### ***3.c. Land tenure***

Sub-optimal use and management of watershed natural resources can largely be explained by the tenure regime under which the users operate. The more insecure the user feels with regard to his/her long term rights to use a particular resource, the more incentive there is to exploit it to the maximum over the short term without considering its long-term sustainability. “Unowned forests are unprotected,” according to James Astill of *The Economist* (2010).<sup>45</sup> Land users require long-term secure rights to use a particular piece of land and to harvest the produce from it before they will invest time and effort in sustaining its long-term productivity. Large parts of the forestlands in the public domain have become de facto open-access resources. Aggravating these problems are policies with inconsistent provisions on land classification, allocation and use. In particular, the provisions of PD 705, Mining Act of 1997, IPRA and NIPAS Law on jurisdiction and uses of watershed areas clash with one another, leading to confusion in strategies and programs being undertaken.

### ***3.d. Misconceptions about watershed management***

One of the most significant factors that shaped the policy and institutional environment is the misconceptions about watershed management. For instance, it has long been thought that watershed management is only about water and that it is

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<sup>45</sup>Astill, J. (2010, September 25). Seeing the wood. A special report on forests by *The Economist*. p. 9.

but a special use in forestry. The poor appreciation of the true concepts and principles underlying watershed management by the various watershed actors and players led to the evolution of policies and institutions that are insufficiently supportive of, if not completely opposed to the achievement of watershed management objectives. A number of provisions in PDs 705 and 1515, LOIs 845, 917 and 1002, and EOs 223 and 224 of 1987 focus watershed management for the protection and conservation of water resources precluding the management of many watersheds for their multiple uses.

### ***3.e. Poverty and economic disadvantage***

Poverty is the underlying cause of much watershed degradation within the Philippines. The upland and mountain areas of the country are generally the poorest and least developed. The onsite users of watershed resources are predominantly rural. Lack of alternative income-generating activities mean that most of them are dependent on small-scale farming and/or forestry activities for their livelihood.

### ***3.f. Lack of markets***

Geographic isolation and the lack of a well-developed market infrastructure in most upland areas mean that the agriculture and forestry activities of upland communities have remained predominantly subsistence activities. The opportunities for increasing cash income are largely restricted to a small number of commodities that keep well, have high value or are easily transported. Lack of good roads and markets limits the scope for promoting the growing of perennial

tree crops, as an alternative to annual food crops on steep slopes, if the produce is perishable and bulky.

### ***3.g. Inappropriate conservation technologies***

While a range of soil and water conservation, agro-forestry and forestry technologies have been developed for upland areas, its implementation typically requires substantial investments in labor, time, money and material resources – items that many households do not have. Hence, even when aware of the need to adopt specific sustainable land management practices, a household's socio-economic constraints may prevent it from being in position to do so. Many current conservation recommendations (e.g., SALT, terracing, reforestation) have high initial investment costs when compared to current land uses and the incremental development costs are beyond what most rural households can absorb. There is a strong need to develop strategies and technologies that are cost effective, socio-culturally adaptive and ecologically friendly.

### ***3.h. Limited institutional support services***

The extension, research and conservation support services available to various watershed resource users in general and to upland communities in particular are very limited or nonexistent. The bulk of the available manpower and financial resources that the LGUs and DA devote to agriculture have been concentrated on the development of paddy rice and commercial export crops within the lowlands. For most hill farmers there is very little, if any, extension advice available on how to improve productivity of traditional upland food crops.

Farmers in alienable and disposable land lack extension advice on how to grow trees.

### ***3.i. Conflicting institutional mandates***

Organizational problems related to the integrated management of watersheds stem from the restricted, and often conflicting mandates of the different development agencies operating in upland areas. In particular, there is often a conflict of interests and legal responsibility over land use within watershed areas between DENR, DA, DAR and the LGUs. There is a need to clarify the jurisdiction and scope of responsibilities among the various agencies as provided for in various legislations such as PDs 705, 1159, EOs 192, 223 and 224 of 1987, 258 of 1995, RAs 4850 amended by PD 813, RA 8371, LOIs 845 and 1002, and the Provincial Water Utilities Act of 1973.

### ***3.j. Underpricing of watershed resources***

The undervaluing of the natural resources of a watershed, notably its water and forest products, has failed to promote the efficient use of water or encourage improved natural forest management or large-scale reforestation. There is little incentive to pursue improved watershed resource management practices if the end users of the resource do not pay a fair price to those who manage the resource.

## **4.2d 3<sup>rd</sup> Dimension: Environmental Vulnerability Risks**

We have so far discussed the state of the environment – highly degraded; and the state of watershed management – inadequate at best, completely absent and blind

to destructive agricultural and forestry practices at worst, which is often the case in most of the country's watersheds.

The third dimension of the crisis is our country's environmental vulnerability. According to the United Nations Environment Programme's Environmental Vulnerability Index (EVI), the Philippines is "extremely vulnerable."<sup>46</sup>

The EVI is a set of 50 "smart indicators" under five categories, namely: weather and climate, geology, geography, resources and services, and human populations. These "smart indicators" are assessed to arrive at an overall picture of environmental vulnerability.

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<sup>46</sup>EVI Country Profiles (2005). *Environmental Vulnerability Index*. Retrieved September 2011, from [vulnerabilityindex.net](http://vulnerabilityindex.net)

**Table 3. 50 Smart Indicators: Philippine Vulnerability Result**

	1	2	3	4	5	6	7
Wind 1	■	■					
Dry 2	■	■	■	■	■		
Wet 3	■	■	■	■	■	■	■
Hot 4	■						
Cold 5	■						
SST 6	■	■	■				
Volcano 7	■	■	■	■	■	■	
Earthquake 8	■	■	■	■	■	■	
Tsunami 9	■	■					
Slides 10	■	■	■	■	■	■	■
Land 11	■	■					
Dispersion 12	■	■	■	■			
Isolation 13	■	■	■	■	■		
Relief 14	■	■					
Lowlands 15	■						
Borders 16	■	■					
Imbalance 17	■						
Openness 18	■	■	■	■	■	■	■
Migratory 19	■						
Endemics 20	■	■	■	■	■	■	■
	■	■	■	■	■	■	■
Endangered 22	■	■	■				
Extinction 23	■	■	■				
Vegetation 24	■	■	■	■	■	■	■
Loss Veg. 25	■	■	■	■	■	■	■
Fragment 26	■	■	■	■			
Degradation 27	■	■	■	■	■	■	■
Reserves 28	■	■	■	■	■		
MPAs 29	■	■	■	■	■		
Farming 30	■	■	■	■	■	■	■
Fertilisers 31	■	■	■	■			
Pesticides 32	■	■	■	■			
Biotech 33	■	■	■	■	■		
Fisheries 34	■	■	■	■	■	■	
Fish Effort 35	■	■	■	■			
Water 36	■	■	■	■			
Air 37	■	■	■	■	■		
Waste 38	■	■	■	■			
Treatment 39	■	■	■	■			
Industry 40	■	■	■	■	■		
Spills 41	■	■	■	■			
Mining 42	■	■	■	■			
Sanitation 43	■	■	■	■	■	■	■
Vehicles 44	■	■	■	■			
Density 45	■	■	■	■	■	■	■
Growth 46	■	■	■	■	■	■	■
Tourists 47	■	■	■	■	■	■	■
Coastal 48	■	■	■	■	■	■	■
Agreements 49	■	■	■	■	■	■	■
Conflicts 50	■	■	■	■	■	■	■
LEGEND:							
Weather and climate		■					
Geology		■					
Geography		■					
Resources and services		■					
Human populations		■					

Source: UNEP, vulnerabilityindex.net, 2005

Table 3 shows the Philippines' vulnerability assessment result. EVI scores range from 1 to 7: 1= resilient; 2= at risk; 3=vulnerable; 4=moderately vulnerable; 5 = highly vulnerable; 6 to 7= extremely vulnerable.

The country's issues of greatest environmental vulnerability are: wet periods, slides, environmental openness, loss of cover, degradation, intensive farming, sanitation, population density, population growth, coastal settlements and conflicts.

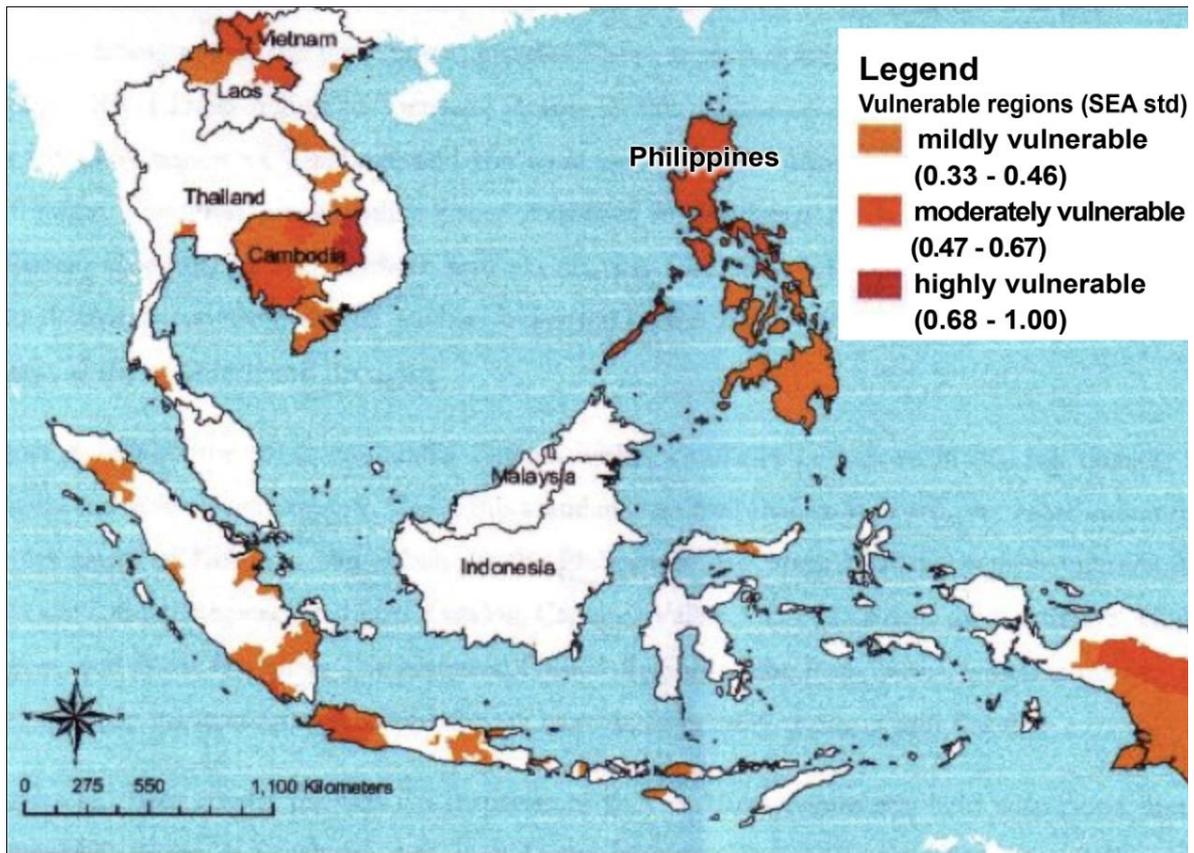
**Table 4.** State of the Country's Vulnerability

	SCORE	DATA %
Environmental Vulnerability Index	402	94
Classification	Extremely vulnerable	

Source: UNEP, vulnerabilityindex.net, 2005

Table 4 represents the overall vulnerability level of the Philippines. An overall score of more than 365 places a country in the "extremely vulnerable" category. Based on 94% of the data collected by the EVI scientists, the Philippines yielded a score of 402. The vulnerability index is applicable to an entire country and the Philippine rating is therefore highly applicable to the problem area in Mindanao, as tragically validated by the Sendong disaster.

**Figure 16.** Vulnerable Regions in Southeast Asia including Philippines



Source: Yusuf and Francisco (2009). Climate Change Vulnerability Mapping for Southeast Asia

Yusuf and Francisco (2009) illustrate the climate hazard map of Southeast Asia including the Philippines and list cyclones, landslides, floods and droughts as its dominant hazards. The regional index of vulnerability ranges from 0 to 1, with .68 to 1 as the “highly vulnerable” category. The Philippines is classified as “highly vulnerable.” Among the areas in the Philippines which are classified as having the highest vulnerabilities are: National Capital Region (NCR), Southern Tagalog, Cagayan Valley, Central Luzon, the Cordillera Administrative Region and Bicol Province, with the National Capital Region particularly ranking as the most likely vulnerable to multiple climate hazards because of its high population

density. NCR is the seventh most vulnerable among the provinces/districts in all of Southeast Asia.

**Table 5.** Vulnerability Ranking of Philippine Regions, 2009

Ranking in		Area
Country	S E A	
1	7	National Capital Region
2	27	Cordillera Administrative Region
3	30	Central Luzon
4	34	Cagayan Valley
5	36	Bicol
6	40	Ilocos
7	44	Southern Tagalog
8	60	Eastern Visayas
9	74	Northern Mindanao
10	86	Central Visayas
11	87	Western Mindanao
12	96	Western Visayas
13	103	Southern Mindanao
15	105	Central Mindanao

Source: Yusuf and Francisco, (2009): Climate Change Vulnerability Mapping for Southeast Asia

Table 5 shows the vulnerability ranking of selected Philippine regions. Of the 15 areas assessed, the National Capital Region is the most vulnerable while the most resilient is Central Mindanao. Northern Mindanao, where Bukidnon and Lanao del Sur are located, ranks number 9 in the country and number 74 out of 530 districts in Southeast Asia.

Awareness of environmental vulnerability is essential to watershed planning and management because the EVI is a predictive tool. “Vulnerability is a new way of looking at an age-old problem. Instead of focusing just on what has been going wrong in the past and the impacts of hazards, vulnerability gives us the opportunity to focus on getting things right for the future. As a future-focused approach, vulnerability is a way of identifying and preserving strengths (resilience) and strategically improving weaknesses.” (SOPAC, 2004)<sup>47</sup>

#### **4.3 4<sup>th</sup> Dimension: Productivity and population**

The fourth dimension of the Philippine watershed ecosystem crisis is low productivity coupled with high population growth. Erosion and lack of irrigation have made the soil less and less fertile. Hunger for land has pushed an ever-growing population to encroach on more and more forestlands, only to eke out a subsistence existence.

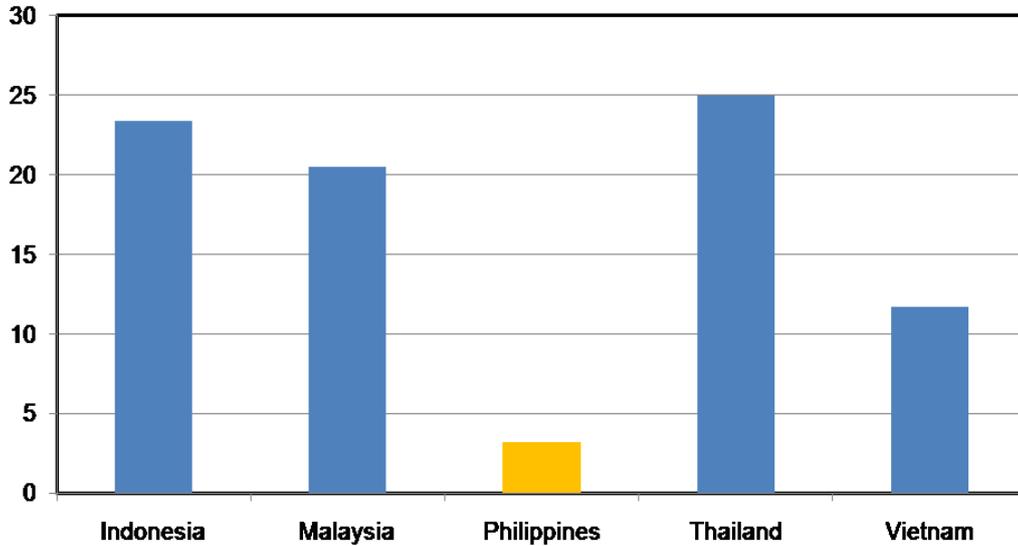
The country’s agricultural, fishery and forestry sector employs more than one-third of the country’s labor force and yet it contributes only about 15% to the annual Gross Domestic Product. With such low productivity, the country lags far behind its Asian neighbors in the export of agricultural products. In 2007, the Philippines exported a cellar-dwelling figure of US\$3.2 billion worth of agricultural products as against Thailand’s US\$25 billion. Despite having the second longest aggregate coastline next to Indonesia, the country is also far behind

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<sup>47</sup> United Nations Environment Programme and South Pacific Applied Geoscience Commission (2004). Environmental Vulnerability Index Frequently Asked Questions. *EVI: Description of Indicators*.

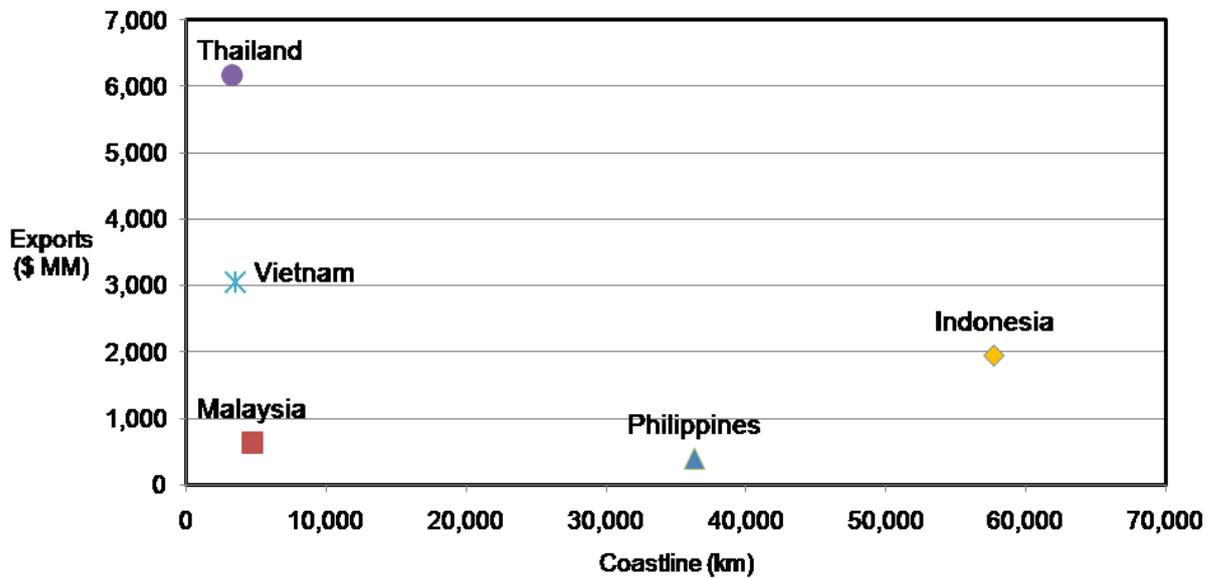
in the export of marine products. Figures 17 and 18 show this very dismal picture of low productivity and uncompetitiveness.

**Figure 17. Agriculture Exports in Billion US\$**



Source: “Food for Thought: How Agribusiness is Feeding the World” by Rolando T. Dy World Trade Organization

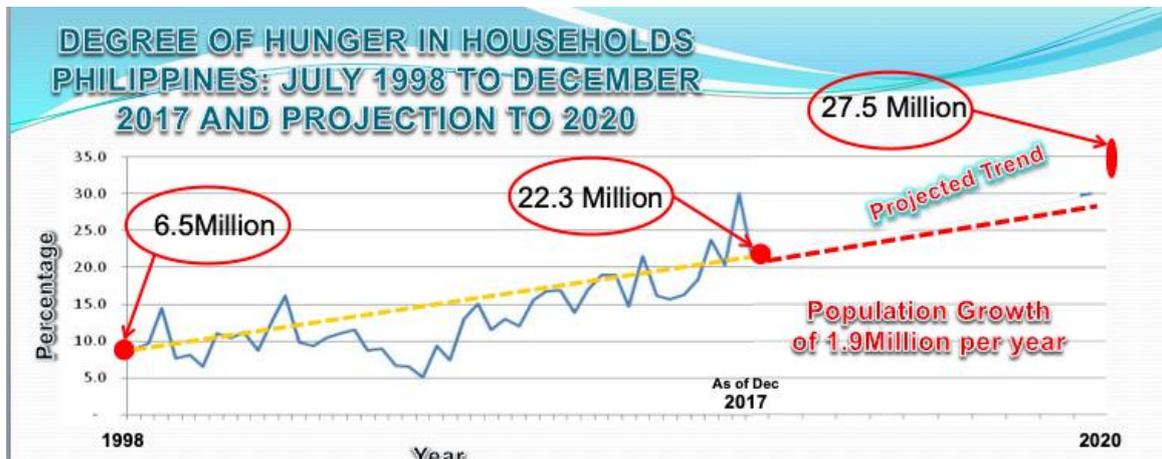
**Figure 18. Seafood Exports**



Source: “Food for Thought: How Agribusiness is Feeding the World” by Rolando T. Dy International Trade Centre; Central Intelligence Agency

Not only is the Philippines unable to produce enough and compete in the agricultural and fishery export market, it cannot even produce enough to feed its own people.

**Figure 19 and Table 6.** Recent Projections on the Degree of Hunger in the Philippines



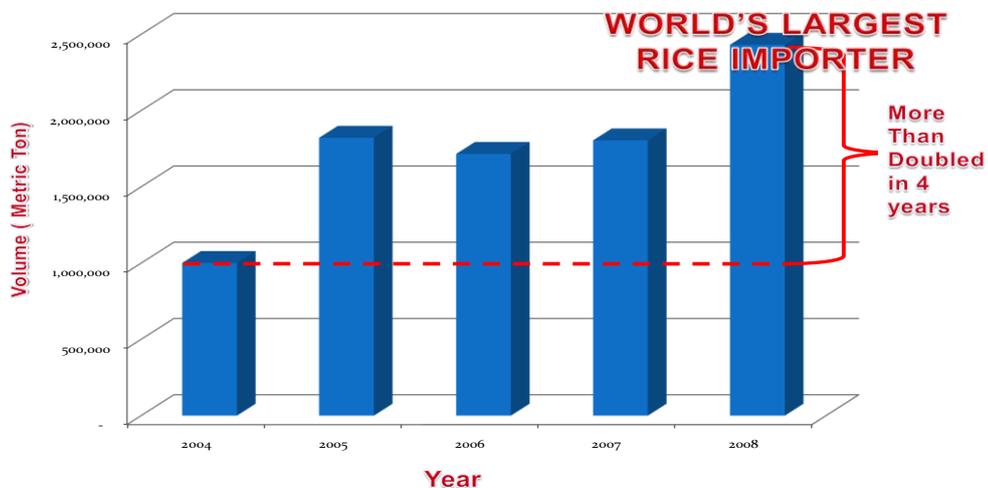
Year	Total Population	Hunger Percentage
1998	73M	9%
2017	98M	23%
2020	110M	25%

Sources: Social Weather Stations; Central Intelligence Agency web site

There is evidence of increasing degree of hunger amongst Filipinos. The above figure and table show the rapid rise in population impacting on the poverty and hunger rate in the country. According to recent estimates of the Social Weather Report, degree of hunger may rise as much as 25% (meaning as many as almost 28 million people will not have enough food to eat – meaning involuntary hunger) by the year 2020 unless population growth is managed well or enough

food is put on the table to feed the people. Compare this with the actual population in the current year 2019 of about 108 million people, the projection made earlier is not too far off from the emerging reality the ground today. The next few years may in fact see an even more dramatic impact on hunger and poverty given the gravity of the ongoing COVID 19 crisis globally including in the Philippines. Recent estimates (May 2020) on the impact of the crisis show that the economy last lost over Peso 2 Trillion and as many as 25 million jobs in just the first four months of the year.

**Figure 20.** Philippine Rice Imports



Source: National Food Authority

The above figure illustrates the sharp increases in rice imports, which is the basic staple food of the country. In 2008, when the financial crisis unfolded and there was at the same time the food price crisis, imports of rice doubled rising to as much as 2.4 million metric tons. In more recent years have been persistent and stayed at about 2 million tons per year. These may again likely increase due to the COVID pandemic which is now unfolding. Such large imports eat into the

precious foreign exchange of the country and show the country's high dependence on rice imports. The glaring lack of self-sufficiency in basic food commodities opens us to political and social instability as well.

#### **4.4 5<sup>th</sup> Dimension: Climate Change Worsens Scenarios**

The country's vulnerability is further heightened and its economic productivity further threatened by the very real specter of climate change. Figure 21 shows that an estimated 20 million hectares or 67% of the country's total land area may be severely affected by climate change (Godilano). These adverse events include droughts, floods and landslides – singly or in combination.<sup>48</sup>

Godilano pointed out in a television interview (soon after the Sendong disaster) that in 2009, the Philippines ranked 9<sup>th</sup> among the countries most vulnerable to disasters and the impacts of climate change. As if that was not bad enough, our climate change vulnerability ranking rose rapidly: "In 2010, we were number six; in 2011, we are third. Now, with what happened in Cagayan de Oro, we may already be number one," the climate change scientist warned.<sup>49</sup>

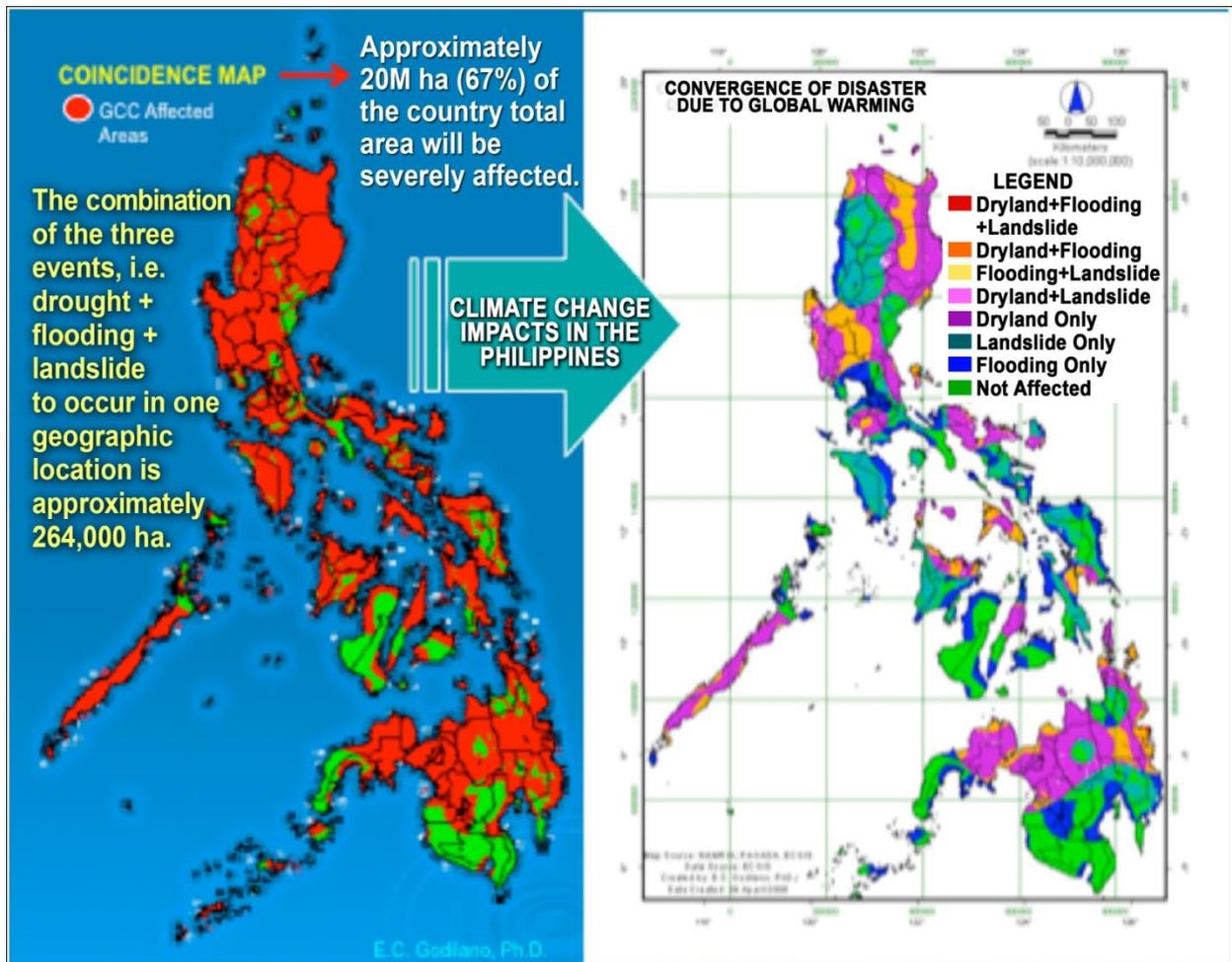
This is clearly worrisome, as there is the phenomenon of "acquired (and escalating) vulnerability," whereby the fewer the efforts to mitigate the impacts of climate change, the more vulnerable we become.

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<sup>48</sup> Godilano, E. C. (2010, November 16-17). *Disaster Risk and Impacts of Climate Change Challenges and Opportunities*. PowerPoint presentation in a workshop in Cagayan de Oro City.

<sup>49</sup> \_\_\_\_\_ (2011, December 27). Television interview aired on ANC (ABS-CBN News Channel).

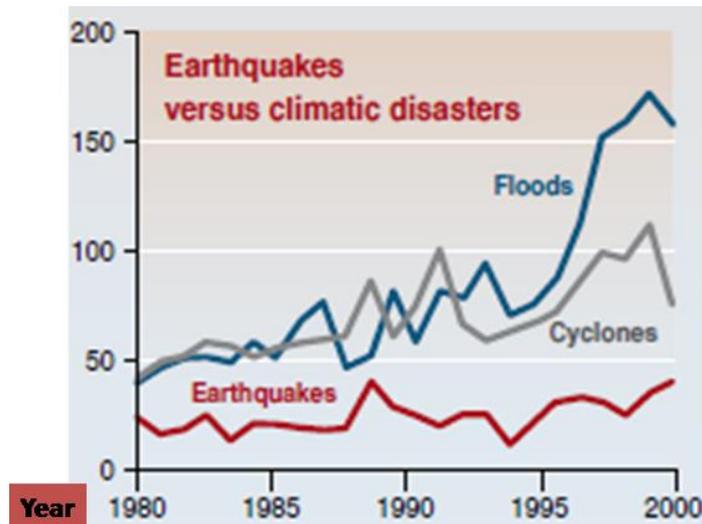
**Figure 21.** Climate Change Impacts in the Philippines



Source: Godilano, 2011

Climate change is clearly worsening climatic natural hazards like floods and typhoons. Along with the rise in global temperature and the accelerated melting of glaciers and land-based ice is the sharply increasing frequency of extreme floods and cyclones (typhoons) compared to the generally stable frequency of earthquakes, which are a geologic natural hazard. Figure 22 below illustrates this.

**Figure 22.** Frequency of Earthquakes versus Climatic Disasters



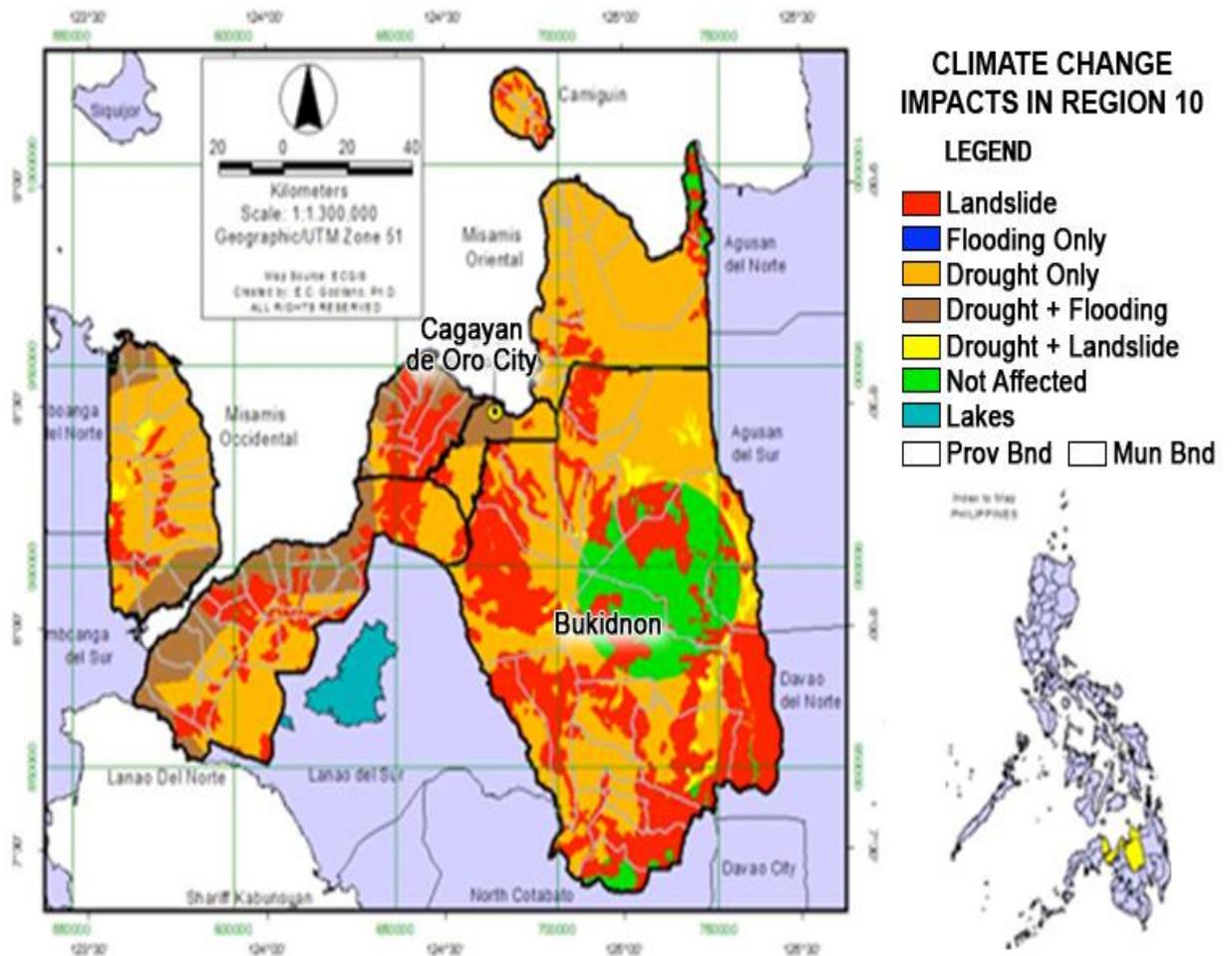
Source: UNEP, 2008

Ewing points out that the Philippines faces “risks to water security and agriculture deriving from changing precipitation patterns. Increased precipitation, particularly in large-scale weather events, facilitates erosion and runoff. The IPCC predicts an increase in runoff between 10 and 40 per cent for wet tropical regions at mid-latitudes such as the Philippines, and predicts that the negative effects of such precipitation increases will outweigh the positive. The Manila Observatory forecasts ‘dry days that are drier and wet days that are wetter’ and asserts that climatic alterations in the timing and volume of rainfall will adversely affect crop production in many of the country’s agricultural zones.”<sup>50</sup>

<sup>50</sup> Ewing, J. J. (2009, November 23). *Converging Peril: Climate Change and Conflict in the Southern Philippines*. S. Rajaratnam School of International Studies, Singapore. p. 20.

Figures 23 and 24 below show the climate change impacts for Region 10, of which Bukidnon is a part; and the climate change impacts for the watersheds of Cagayan de Oro, which are mostly found in Bukidnon.

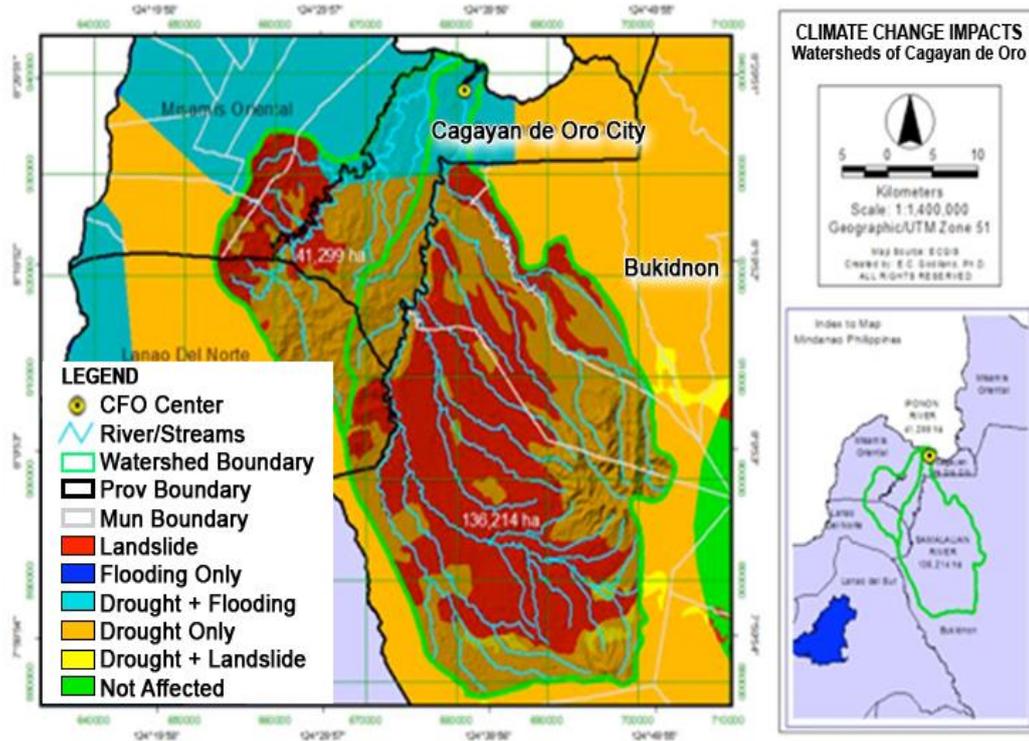
**Figure 23.** Climate Change Impacts in Region 10



Source: Godilano, 2011

Most of Northern Mindanao, particularly Bukidnon, faces the threat of landslides; drought; drought and flooding; and drought and landslides.

**Figure 24.** Climate Change Impacts on Watersheds of Cagayan de Oro



Source: Godilano, 2011

Figure 25 shows that even this newly-constructed flyover (elevated roadway) in downtown Cagayan de Oro is flooded during an afternoon downpour.

**Figure 25.** Flooded Flyover in Cagayan de Oro



Source: Ted Jaranilla, 2011

Widespread flooding in the city was becoming more frequent, the most recent of which were in January and November 2009.

**“Twas the Night the Mountains Came Rolling Down the Rivers before Christmas”**

These proved to be the precursors to “the big one” that devastated Cagayan de Oro and Iligan on December 16-17, 2011. The inland tsunami unleashed by typhoon Sendong and the vulnerabilities it unmasked exhibited all the five dimensions of disaster this researcher has described.

***Degraded environment***

The huge logs and other forest debris carried by the rainwater rampaging down the mountainsides show without any shadow of a doubt, the unabated cutting of trees going on in what pitifully little forest remains. These logs were the battering rams that crushed homes, cars and people as the floodwaters carried them out to sea. The logs that flowed down the Iligan River alone were estimated to amount to about 1.85 million board feet of lumber, enough to fill 185 10-wheeler cargo trucks and enough to clog a five-kilometer stretch of coastline.<sup>51</sup>

Soil erosion and the resulting heavy siltation of the Cagayan, Iponan, Mandulog and Iligan Rivers made them shallower, unable to absorb more of the heavy rains brought by Sendong, which dumped a month’s worth of rainfall in less than 24 hours. To make things worse, it was high tide, and so the rivers could not drain into the sea fast enough and overflowed their banks, going up to a kilometer inland. Fast, deep, deadly, the viscous, debris-laden currents came in the dead of

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<sup>51</sup>Rosauero, R. D. (2012, January 21). Volume of ‘killer’ logs in Iligan awes execs. *Philippine Daily Inquirer*. p. A15.

night, in the middle of a power outage, at the height of the howling typhoon winds, catching riverside and inland communities when they were most vulnerable.

**Figure 26.** Sendong's Rampaging Flash Flood



*The water rose in seconds, catching many people by surprise.*

Source: sugarcanenomads.com, 2011

**Figure 27.** Logs and Other Forest Debris Litter the Coast after Sendong



Source: blogs.agu.org, 2011

Even weeks after the disaster, many of the logs have not been cleared and disrupt the lives and livelihood of the fishermen and their families who live along the shoreline. Many city streets still have waist-deep mud, an indication of the extent of erosion and volume of silt brought down by the flashflood from the Bukidnon and Lanao del Sur uplands.

### ***Watershed mismanagement***

The lack of a thorough-going, effective watershed management system is apparent. Whatever watershed management programs that have been attempted were shown for what they are: inadequate, short-term, far from strategic and integrated. In many cases there is no watershed management at all, and worse, some local governments and DENR personnel themselves condone illegal logging.

Compounding the situation in the uplands is the mismanagement and lack of foresight by local governments downstream. Products of a bygone era of fair breezes and gentle climes, the political and cultural mindset of the politicians and the populace is complacent and not disaster-ready. Thus, selfish political interests have superseded good governance based on the sound enforcement of zoning and building codes, leading to the outright disregard of geohazard maps and repeated warnings by environmentalists and climate scientists.

**Figure 28.** Tsunami-like Devastation



*Sendong aftermath: Building in the path of rivers means eventually not having any buildings left.*

Source: blogwatch.tv, 2011

### ***Environmental vulnerability***

Of the country's 11 issues of greatest environmental vulnerability identified by UNEP, eight were present in the Sendong disaster: wet periods, slides, loss of cover, degradation, intensive farming, population density, population growth, and coastal settlements.

Table 8 below shows these extreme risk indicators and how they may be mitigated.

**Table 7.** Extreme Vulnerability Issues Present in Sendong Disaster

<b>EVI INDICATOR</b>	<b>DESCRIPTION</b>	<b>MITIGATION</b>
Wet periods	Vulnerability to floods, cyclones, wet periods, stress on land surfaces and ecosystems subject to flooding and disturbance. This indicator captures not only the number of months with significantly higher rainfall, but also the amount of excess.	This issue cannot be directly influenced by human actions, but resilience against effects could be built up in other areas which are amenable to improvement (e.g. maintain/improve forest cover; promote good land use practices)
Slides	Vulnerability to habitat disturbance and persistence of ecosystems and species from catastrophic shifts in the land surface. The primary and cumulative effects of slides would be especially important if there are many endangered species, sensitive ecosystems, and interactions with ongoing human impacts.	The issue cannot be directly influenced by human actions, but resilience against effects could be built up in other areas which are amenable to improvement (e.g. maintain/improve forest cover; promote good land use practices.)
Loss of cover	This measures the rate of loss or gain of natural vegetation cover in countries. It focuses on biodiversity, ecosystem resilience, the capacity of a country to attenuate pollution, prevention of soil loss and on-going soil development, reduction of runoff, recharging of groundwaters and soil formation.	The first action will be to prevent further losses of whatever natural vegetation cover remains in a country. General resilience building could also be achieved through rehabilitation of degraded habitats, allowing areas to regenerate, better land use and creating more reserves in terrestrial habitats.
Degradation	This indicator captures the status of loss of ecosystems in a country. Degraded land means that which can no longer revert to	Mechanisms that are degrading the land should be identified and arrested as soon as possible.

<i>Table 8 cont.</i>	its natural ecosystem without active and costly rehabilitation by humans to reverse permanent damage, if at all. Types of degradation include water and wind erosion, chemical and physical deterioration, agriculture, deforestation and grazing.	Programmes for rehabilitation and/or allowing natural regeneration could be put in place. General resilience building could also be achieved through improvements in land use and other related issues, such as creating more reserves in terrestrial habitats.
Intensive farming	This indicator captures the risk of pollution, eutrophication, ecosystem loss or damage and the risk of diseases and plagues. It focuses on lands being used for intensive agriculture, which we define as those in which the wastes produced over the land are in excess of the ability of that same land area to attenuate them. Intensive farming includes the farming of poultry, pigs, aquaculture, and some farming of cattle and other animals kept in feed lots. Intensive farming usually involves clearing of land, feeding, heavy use of pesticides and other medications and a concentrated production of wastes.	The main risks of intensive agriculture relate to use of medicines pesticides and other chemicals and production of concentrated wastes. Mechanisms for reducing their use and/or impacts on the environment through better husbandry and treatment of wastes would reduce risks associated with this issue.
Population density	This is a proxy measure for pressure on the environment resulting from the number of humans being supported per unit of land. The greater numbers of people increases pressure on the environment for resources, for the attenuation of wastes and physical disturbance of the environment.	Policies that keep human population pressures within sustainable limits. This includes lifestyle choices and minimizing the ecological footprint and levels of consumption. General resilience can be built by maintaining and restoring damaged ecosystems, minimizing wastes and creating terrestrial and aquatic reserves.

*Table 8 cont.*

Population growth	This indicator focuses on the potential for damage relating to expanding human populations. It signals increasing rates of habitat damage, exploitation of natural resources and disposal of wastes that will need to be assimilated into the environment. It also captures the risk of infrastructure not being able to keep up with demand for issues such as waste treatment.	Policies that keep human population pressures within sustainable limits. This includes lifestyle choices and minimizing the ecological footprint and levels of consumption. General resilience can be built by maintaining and restoring damaged ecosystems, minimizing wastes and creating terrestrial and aquatic reserves.
Coastal settlements	This indicator captures the focus of stress on coastal ecosystems, often the most productive living areas in a country, through pollution, eutrophication, resource depletion and habitat degradation. The adjacent water areas are capable of spreading pollution widely in aquatic habitats and will not tend to allow for attenuation over upland areas. Countries with heavy densities of human populations living on their coastal areas are likely to be damaging some of their most productive and diverse areas and negatively affecting the resilience of the country to natural disasters such as cyclones, tsunamis, etc.	Policies that manage ecosystems and their use at the interface between land and sea, lakes or rivers. Emphasis should be on fragile habitats such as swamps, mangroves, estuaries, lakes. General resilience can be built by maintaining and restoring damaged ecosystems and creating reserves.

Source: SOPAC, 2004

### ***Low Productivity Coupled with High Population Growth***

Mindanao-wide, there is no farmer who has been spared the reduction in planting cycles from three to at most two a year. Sometimes it is even less, when droughts or floods hit, farms are reduced to one harvest and have to absorb their

losses. Many are forced to use expensive chemical fertilizers in the effort to increase their yield but end up in greater debt when disasters strike and crops are lost or damaged.

Water shortages have severely affected productivity. Mindanao farmer-businessman John Perrine narrates that in Davao, “By the early 1990s, to maintain banana production – commercial farms began to install irrigation systems – because the rainfall had become sporadic, with more frequent periods of low rainfall that was insufficient to maintain the 49 mm per week required by bananas to maintain peak production...today, during the dry season, farms that used to be able to sustain full irrigation with water pumped from rivers have been short by 30-75% of water because the rivers have run so low, due to loss of trees in the mountains to hold rain water for slow release over the dry months.” (See Appendix B for Perrine’s full write-up on the issue of water shortages.)

Soil erosion is also a direct culprit of diminished productivity. Adornado and Yoshida observe that an earlier study by Bakker et al (2003) discovered that “a yield reduction resulting from soil erosion has been estimated to be 4% per 10 cu m of soil loss. This means that the crop yield in areas suffering a soil loss of 10 tons per hectare per year will decline by an average of 4% per decade. Higher rates of soil erosion could result in even greater yield reduction.”<sup>52</sup>

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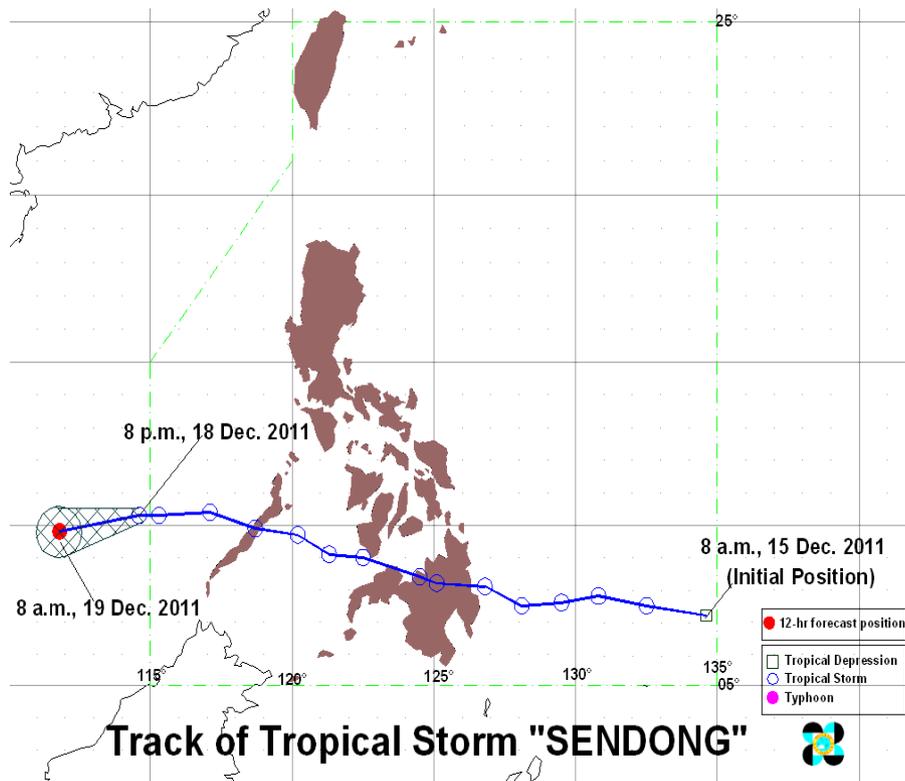
<sup>52</sup> Adornado, H. A. and Masao Yoshida, (2010). Assessing the Adverse Effects of Climate Change: A Case Study in the Philippines. *Journal of Developments in Sustainable Agriculture* 5: 141-146. Retrieved November 2011, from [www.jstage.jst.go.jp](http://www.jstage.jst.go.jp)

Population pressure has long been identified as a cause for unbridled extraction of natural resources. It has also pushed burgeoning urban populations to settle in extremely hazardous areas, as in the now infamous Isla de Oro, a river delta formed out of silt and sand right in the middle of the Cagayan River. Many of the Sendong disaster victims were residents of this river delta; swept out to sea, many remain missing and unaccounted for.

### *Climate Change*

Northern Mindanao has often been described as “typhoon-free.” Not anymore. Changes in precipitation levels, patterns and frequency are among the most significant effects of global climate change. Forming over the Pacific Ocean to the east, typhoons before would invariably hit central or northern Philippine islands. This time, Sendong strayed to the south and gave Bukidnon, Cagayan de Oro and Iligan a direct hit. The amount of rain it brought was unusual for the area: 350 millimeters – about a month’s worth of rain which fell in less than 24 hours.

**Figure 29.** In Sendong's Path: Bukidnon, Cagayan de Oro and Iligan



### Sendong Casualties and Damage

As of early January 2012, the full count of casualties was not in yet and may never be. The latest official figures list 1,268 dead and 181 missing.<sup>53</sup> But there are persistent accounts of underreporting of casualties. A geologist who was at Iligan says, in some cases “There was no one to report the missing because (entire) communities were wiped out.”

Loss and damage to infrastructure, homes and other property was estimated at more than PhP1.4 billion. The Department of Agriculture assessed crop damage at PhP310 million.

<sup>53</sup> LBG (2012, January 26). NDRRMC: ‘Sendong’ death toll goes up again; 9 more confirmed dead. *GMA News Online*. Retrieved from <http://www.gmanetwork.com/news/story/245793/news/nation/>

Cagayan de Oro and Iligan have been declared calamity areas. National government agencies, the local government units and numerous domestic and international relief agencies and civic groups and individuals are now struggling to meet the most basic needs, particularly for shelter, food and health, of 50,000 people who have been rendered homeless by the disaster.

**Figure 30.** Mud and Silt Cover the Living and the Dead



*Shock, tears and grief mix in the mud left by Sendong: “The far greater tragedy is the trauma and loss for people and families, a nonphysical dislocation so wrenching and indefinite.”<sup>54</sup>*

Source: [ecowastecoalition.blogspot.com](http://ecowastecoalition.blogspot.com), 2011

Even as everyone is doing his or her best to help meet the most immediate needs of rescue, resettlement and rehabilitation, there is the dire and just as immediate need to prepare for the next potential calamity looming on the horizon.

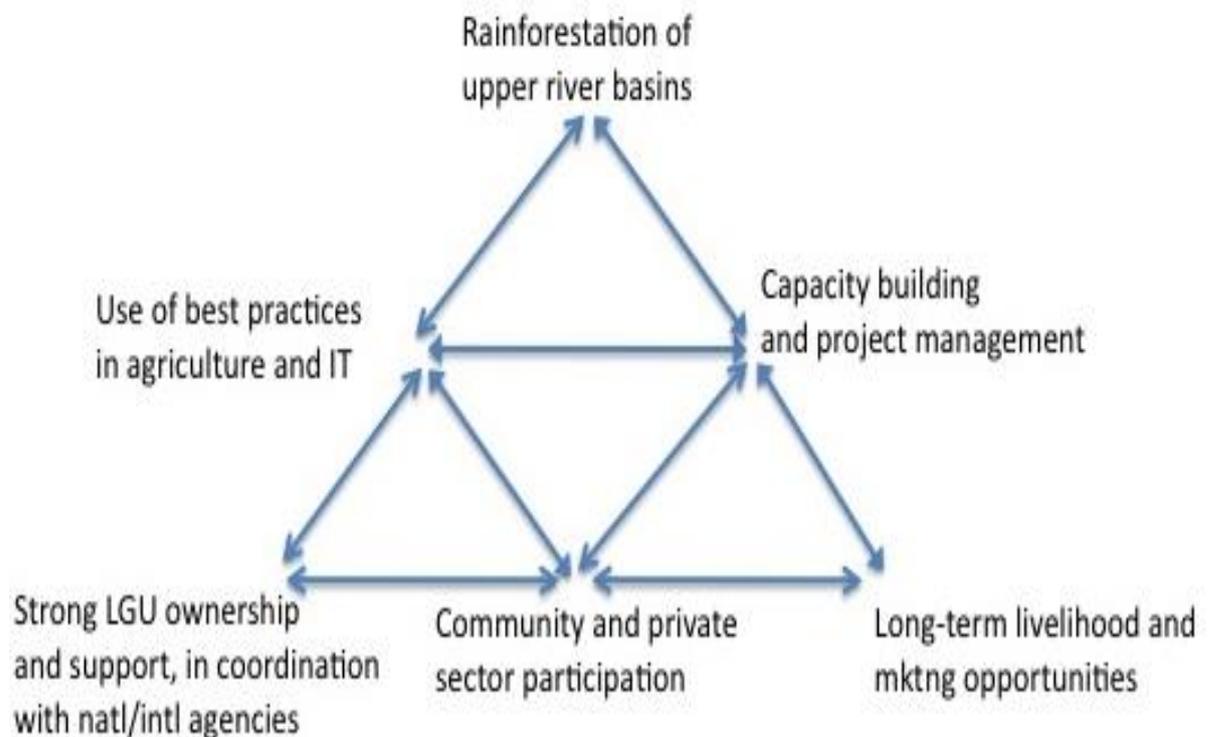
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<sup>54</sup> Acosta, Nereus J. R., (2012, January 1). Building resilience and adaptation. *Philippine Daily Inquirer*. p. A14.

#### 4.5 Strategic Approach Pyramid

The multiplicity and complex interrelatedness of the problems, issues and concerns that have to do with watershed management require a strategic approach that will address these in an integrated and sustainable manner. Proposing a strategic approach as illustrated by the following pyramidal diagram, this researcher hopes to help reverse the slide of the watershed ecosystem in the critical areas investigated in this study.

**Figure 31.** Strategic Approach Pyramid



The Strategic Approach Pyramid outlines the features of a long-term sustainable solution that will avoid the pitfalls of various other programs initiated in the past. The base of the pyramid rests on the wide bedrock of strong local government ownership and support, in coordination with national and international

agencies; community and private sector participation; and long-term livelihood and marketing opportunities for the buffer zone communities. The middle part of the pyramidal approach will be the core of operations: the use of best practices in agriculture, forestry and information technology; and capacity-building and project management. The apex of the strategic approach shall be its physical and psychological center: the rainforestation of the upper river basins.

The various components of the strategic approach are interlocking and mutually supportive, like a real pyramid, that will manage and conserve the watershed ecosystem and benefit all stakeholders well into the future.

#### ***Local Government Support and Ownership in Coordination with National and International Agencies***

In the course of this researcher's data-gathering and various presentations over the past three years, a clear consensus of ownership and support has been built among various stakeholders of the targeted watershed ecosystems in Bukidnon and Lanao del Sur. One clear manifestation of this is the issuance by the Sangguniang Panlalawigan of Bukidnon of an agreement expressing full support for the rainforestation of the province's upper river basins. Another agreement on the approval and support was provided by the multisectoral Protected Area Management Board (PAMB) to HFI for its proposed rainforestation in the Kitanglad Mt. Range to proceed.

Local government ownership and support is essential to the success of any watershed management program because they are empowered to enact local legislation and enforce national water laws and policies. Local government also

assures program continuity and, hopefully, equity among the various watershed stakeholders.

Linkages have been established with national government agencies, particularly the DENR, to align policies and coordinate programs as well as get funding support. Efforts are under way to modify the current administration's National Greening Program to include mountainside tree planting, instead of just roadside and parks tree planting, since the strategic approach targets "rainforestation" (reforestation and watershed conservation) sites that will generate and hold rainfall and not merely "green" vacant spaces in the countryside.

Many potential donors and international funding agencies are willing to make funds available as long as they can be convinced of the project's viability.

There is close technical consultation with academic institutions like the University of the Philippines at Los Baños (UPLB) and the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) to make sure that the approach is backed by sound, scientific agroforestry practices.

All the formal expressions of support and ownership and the previous and ongoing coordination by this researcher in behalf of and with HFI demonstrate clearly the operationalization of the strategic approach at the field level.

### ***Community and Private Sector Participation***

Numerous advocacy meetings, values-formation sessions and fieldwork among the indigenous populace have made the forest communities active and

willing participants in the reforestation effort. From formerly being threats to the forest, they have now become its guardians.

Unifrutti, a long-established agricultural products company operating in the area, provides logistical support and technical support to the nascent reforestation program. The potential for private sector participation is immense, with the current number of 555 agro-industrial establishments and 320 livestock farms in the province, the biggest of which is Del Monte Philippines, as possible active supporters of the program.

A key area of private sector participation is in the “payment for environmental services” or PES. The idea behind PES is that downstream users should pay upland forest farmers to encourage them to properly manage and conserve the forests to ensure the availability and quality of clean water downstream. This is a touchy subject since many downstream users have long considered water a “free” natural resource. The growing scarcity of water, however, has made the concept of PES more acceptable and ultimately inevitable. It is in the valuation scheme, collection mechanism and remittance to farmers that issues are sure to arise.

A local initiative – in the Maasin Watershed, Iloilo City – in PES has been tried. “Unfortunately, the absence of transparency in the utilization of such funds and the perceived lack of link between such payments to watershed protection did not make this payment sustainable. Efforts to improve the administration of such funds are thus needed. The fact, though, that the Local Government Code

mandates the collection of this payment makes such efforts worth all the more undertaking” notes Francisco (2004).<sup>55</sup>

Internationally, the experience of Mexico in PES yielded very positive results. During its first seven years of implementation (begun in 2003), “Mexico’s PES scheme enrolled more than 3,000 forest owners (collectives and individuals), covering an area of 2,365 square kilometers and involving payments of over US\$300 million. The scheme is estimated to have reduced deforestation by some 1,800 square kilometers, i.e., more than halved the annual rate of deforestation from 1.6% to 0.6%. It has effectively contributed to protecting water catchments and biodiverse cloud forests, in addition to cutting emissions of about 3.2 million tonnes of carbon dioxide equivalent.”<sup>56</sup>

### ***Long-Term Livelihood and Marketing Opportunities***

To ensure sustainability, livelihood buffer zones will be established around the reforestation sites. These buffer zones shall be where farm families will cultivate food for their consumption and engage in short-, medium- and long-term income-generating activities. An average six hectares per farm family shall be developed. Of this, ¼ hectare shall be devoted to the planting of food for family consumption, and 5 ¾ hectares for income generation.

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<sup>55</sup> Francisco, H. A. (2004). Water allocation mechanisms and environmental service payments. In Rola, A. C., Francisco, H. A. and Liguton, J. P. T. (Eds.) *Winning the Water War*. Makati City: PIDS and PCARRD. p. 144.

<sup>56</sup> United Nations Environment Programme, (2010). Mainstreaming the Economics of Nature. *The Economics of Ecosystems and Biodiversity*. p.16.

The projected time frame and agricultural products for livelihood activities are as follows: short-term (18 months) – abaca; medium-term (4-5 years) – bamboo; and long-term (13-15 years) – trees. The necessary infrastructure such as farm-to-market roads and postharvest facilities shall be built to ensure fair returns for the farmers.

The success of the reforestation program rests as much on the provision of long-term livelihood opportunities as on any other program component. An ADB assessment of DENR's Forestry Sector Program (FSP) which was funded by ADB and the Japanese Government in the early 1990s to the tune of US\$240 million, observes that "While the basic cause for the degradation of forests has been poverty, which was acknowledged...as the most formidable among the root causes, and unsustainable harvesting, FSP's focus on reforestation meant that the greatest impact was in the form of cash wages to program participants, which extended only for the period of the loan and then ceased. FSP has not succeeded in providing long-term income sustainability for the upland poor. There has been little or no income improvement for the upland poor resulting from sustainable harvesting of forest products...The area planted under FSP has begun to decline through fires and renewed kaingin activities in some places. There has been a much reduced reforestation program since the end of FSP and limited or no production from the forests established under FSP."<sup>57</sup>

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<sup>57</sup> Asian Development Bank (2001 December). *Program Performance Audit Report on the Forestry Sector Program (Loans 889[SF]/890-PHI) in the Philippines*, pp. 25 and 28.

This litany of failure is doubly painful because the Filipino people have to pay for the multimillion dollar loan that yielded little or no lasting results.

***Best Practices in Agriculture, Forestry and Information Technology***

The peculiar challenges of re-establishing a rainforest on steep mountain slopes overtaken by Cogon and Talahib grasses demand the best methods of soil conservation, weeding, fertilization and soil preparation. The use of calliandra to combat cogon and prepare the ground for the growth of native tree species like lawaan is a cornerstone of the Strategic Approach Pyramid.

Because of the steep slopes of 18° or more and the consequent soil erosion, the pinpointed planting sites for rainforestation have soils that have been severely degraded, with the top soil and organic matter washed away, leaving behind thin subsoil that is clinging to rocky subgrades below.

For example, in most of the projected hectareage targeted for rainforestation in the Bukidnon and Lanao del Sur mountain ranges, only 10% are under secondary forest cover (40-60% denuded), while 90% are already mainly cogonal/talahib grasslands with some shrubs on the lower slopes. These soils have very low soil fertility and are highly acidic with pH ranges of 5.2 down to 4.2. The dominant plant species under such conditions is cogon grass, there being very few other plants that can survive these low fertility, low organic matter, highly acidic conditions without fertilization.

The strategic approach counts among its unique features the use of calliandra, a fast-growing leguminous tree species similar to the ipil-ipil that

combats Cogon and Talahib grasses by forming a thick, shady canopy that discourages the growth and proliferation of these weeds. Unlike the ipil-ipil, whose leaves grow at an angle to the ground (and therefore let sunlight through), the calliandra's leaves grow parallel to the ground and prevent sunlight from penetrating to the soil below.

The elimination of cogon is an essential initial step because there are no indigenous trees that can be successfully grown when planted directly into cogon grass. They cannot compete for such sparse nutrition, and when fertilized, the cogon will be the first to eat the fertilizer. If the trees do initially survive, when the cogon burns over a dry summer at its four-year maturity, the trees will burn with the cogon. The continued presence of cogon guarantees the eventual nonsurvival of planted trees. A UPLB survey found that 90% of previously “re-forested mountain areas” have practically no survival at present – mostly due to eventual destruction from cogon grass fires.<sup>58</sup>

UPLB has found that if an area has already been colonized by cogon, “serial succession” is the only way to establish a final terminal tree cover of forest trees. Serial succession requires an intermediate nurse crop species that can dominate and eliminate cogon grass. The only species that this researcher has found capable of eliminating cogon grass under the highly acidic conditions of its high mountain sites is calliandra, that in turn can be later dominated by true forest species such as lawaan, when it is interplanted with calliandra.

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<sup>58</sup> Based on discussions with Dr. Emil Javier, former chancellor of UPLB, at Kulugmanan, Bukidnon, 2011.

While calliandra is nonindigenous, having originated from Central America, it has been successfully used by HFI in several pilot areas adjacent to the Kitanglad Mt. Range.

Based on several international studies, the Food and Agriculture Organization (FAO) lists the many beneficial uses of calliandra: “The leaves and twigs are used as a high quality protein supplement to cattle and goats feeding on low quality forages and crop residues. Calliandra leaf meal is also used as supplement for poultry...Other uses are for fuelwood, pulp for paper production, erosion control, smothering weeds, firebreaks, ornamental and as green manure in rotation with arable crops. It is also used in alley-cropping systems, as a nurse tree for partially shade-tolerant timber trees and as an effective understory in coconut plantations with about 60% light transmission.”

Calliandra is well-suited for inhospitable conditions, as it grows well even in low fertility, acid soils. Not only that, it grows fast, reaching up to a height of 3.5 meters in six months and producing large quantities of seed. It is extremely hardy as well; in very dry conditions, calliandra trees die back but recover as soon as the rains come.

With all its uses and advantages, Calliandra may turn out to be the “miracle tree” of the rainforestation program.

Another cornerstone of the strategic approach is accurate watershed characterization. Thus, the use of a geographic information system is essential to accurate mapping, pinpointing of problem areas and monitoring of the project’s

progress. The GIS-generated figures in this dissertation illustrate the use of information technology to guide the targeting of critical areas and the wise allocation of project resources.

GIS is particularly useful in Bukidnon because its great variety of landscape types, riparian systems, agricultural and industrial activities, and natural ecosystems require integrated and coordinated management. GIS integrates data from various disciplines and technologies in order to come up with new information that can aid in planning and management.

As there are multiple stakeholders within the URBs, it is important that each is given due representation, and since GIS allows inclusion of data important to stakeholders, a more complete picture can be drawn which is acceptable to all. Even data generated by upland IP communities themselves through community resource mapping can be incorporated into this system and can serve as a tool for empowerment and participation of the de facto managers of the resources in the URBs.

Advances in computing capacity and the widespread access to online information technology make it now possible to introduce GIS without the previous cost restrictions.

Due to its graphic nature, GIS can produce map-based outputs that can serve as guides for decision-making. Data capture can be straight from the field through remote sensing and similar tools, linked with existing databases, then viewed integrated on paper maps or on interactive web-based interfaces. The

ability to visualize information on a geographic reference system makes it easy to establish relationships and plan for appropriate strategies to ensure the stability of the resource base for improved human development. Thus, the integrative nature of GIS makes it the ideal tool for supporting the activities identified under the strategic approach.

Not only will the information generated by GIS be essential to efficient management, it will also be the basis for an aggressive communication and advocacy program that will use the speed, power and reach afforded by the latest in information technology to gain more support and publicize the rainforestation program.

### ***Capacity-Building and Project Management***

All stakeholders should be given the wherewithal to implement and manage the activities necessary to sustain the program for up to 15 years and beyond. The various groups involved should be properly trained, funded, motivated and monitored to support, implement and manage the various rainforestation components and conclude them successfully.

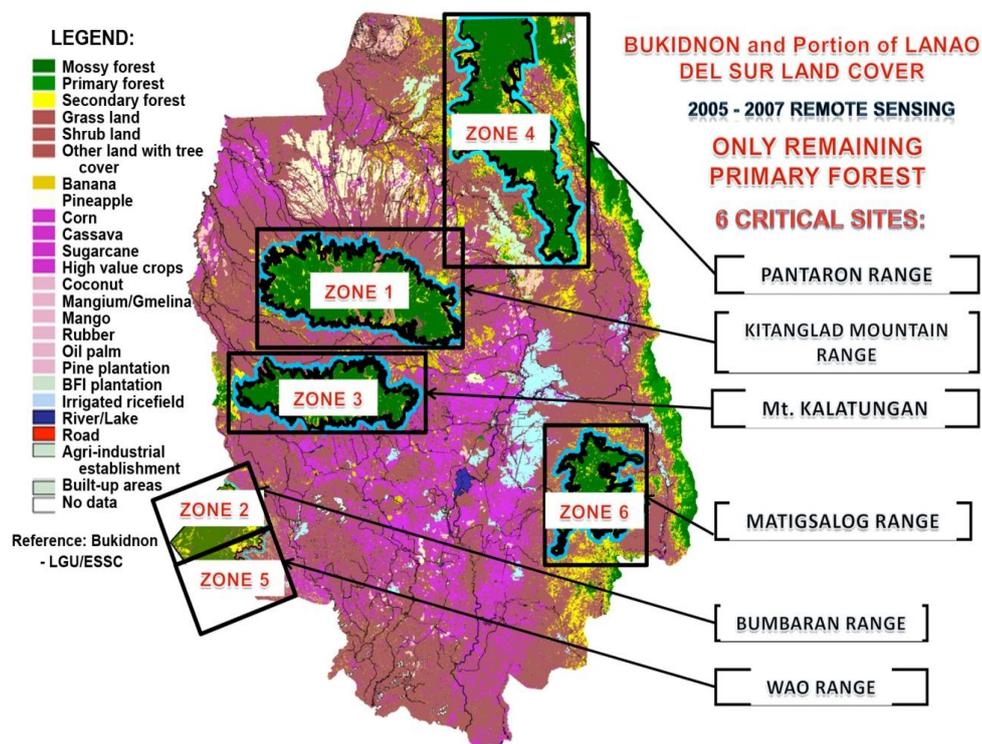
The involvement of stakeholders from the start of the program gives a sense of ownership and ensures that they will see it through to the end. Community organizing and team building are essential to the empowerment and capacity-building of stakeholders to meet challenges and manage the project from day to day.

Project planning, monitoring, resource generation and allocation for a long-term rainforestation project demand management skills that combine advocacy with consensus-building and unflagging determination to meet program targets.

### *Rainforestation of Upper River Basins*

The critical zones in the Bukidnon and Lanao del Sur watersheds where the strategic approach is proposed to be implemented are shown in Figure 32.

**Figure 32.** The Critical Sites of Bukidnon and Lanao del Sur



Source: Environmental Science for Social Change, 2009

There are six mountain ranges within which are the six zones, each of which is a cluster of buffer communities guarding critical watersheds in the mossy forests that need to be protected. The six zones have a degraded or deforested area

of 44,000 hectares. These consist of about half of the secondary forests with 40-60% tree cover, and grasslands and other lands with less than 20% tree cover.

How to combat cogon and successfully recreate rainforests on steep slopes is among the critical issues that the strategic approach faces. As shown in the Strategic Approach Pyramid, we must take the high ground, the ridges of these mountain ranges where the upper river basins are located, the headwaters that determine all downstream impacts and activities.

The areas for intervention in these mountain ranges are clustered into six zones to ensure effective management of resources. The area slice of each zone takes into consideration the watershed divide of the mountain range and its service area, be it for rainfed or irrigated agriculture, potable water or hydropower use. These are the areas where rainforestation efforts will be implemented through “permanent planting” as well as livelihood activities involving “commercial planting” or sustainable agriculture and sound agroforestry practices for the buffer zone communities.

The six zones are described below.

**1 – Mt. Kitanglad Range.** Declared as a full-fledged protected area by Republic Act 8978 in 2000, the Mt. Kitanglad Range Natural Park is characterized by a unique ecological diversity and human communities habituating the natural landscapes. The area to be covered by the program measures a total of 50,684 hectares spanning eight ridges of the mountain range.

**2 – Bumbaran Range.** Comprising the Municipality of Bumbaran, the Bumbaran range has a diverse terrain consisting of mountain ranges, rolling hills,

plateaus, and vast tracts of fertile agricultural lands suitable for a variety of crops. There are two big rivers – the Maridugao River and Sumogot River. The zone will cover 13,776 hectares of the municipality's total area of over 54,000 hectares. Bumbaran Range is the watershed for Lake Lanao, and also serves as a rain shadow for southern Bukidnon.

**3 – *Kalatungan Range.*** The Mt. Kalatungan Range Natural Park is part of the NIPAS created by Republic Act 7586, which provides for the conservation and continuous protection of the area from further destruction, degradation and exploitation of resources. Some 30,769 hectares of the Kalatungan Range will be covered.

**4 – *Pantaron Range.*** Also a protected land, Mt. Pantaron Range has three watersheds that will be protected and rehabilitated under the watershed service area approach – Sawaga, Canayan, and Upper Pulangi. Considered the backbone of Mindanao, the Pantaron Range is one of the last remaining sites of old growth and secondary forests in the area. Situated on the range are one city and three municipalities with 62 sitios, all of which are within the protected area. The zone will cover 50,850 hectares.

**5 – *Wao Range.*** There are over 600 households from the Maranao, Ilongo and migrant groups living in the buffer communities on the Wao Range. The zone will cover 11,225 hectares of the existing watershed and forest areas on the range, protecting nine river systems. Wao Range serves as the rain shadow for southern Bukidnon and other areas of Mindanao to the south.

**6 – Matigsalog Range.** The zone on Matigsalog Range will include buffer communities in the municipalities of San Fernando and Quezon. The total area to be covered consists of 24,472 hectares, with 5,948 hectares to be planted to protect the existing primary forests and rehabilitate the watersheds. The Pulangi River, which feeds the Pulangi IV Hydroelectric Power Plant, and the Davao-Saulog River run through Matigsalog, and will be benefitted by the watershed service area approach.

It is estimated that rainforestation activities in the six mountain ranges will protect at least three times their total area. This means that the reforested 44,000 hectares of the denuded areas (as determined through the use of GIS technology and ground truthing in some cases) will actually be protecting nearly 138,000 hectares of existing forests, which actually serve as a watershed service area of over 800,000 hectares. In addition, around 4,000 households, or approximately 24,000 persons living in the buffer communities will be provided with sustainable means of livelihood. Table 8 below shows the areas to be planted, and the bigger areas to be protected, in the six zones.

These zones are dubbed as the six PEARLs or Program for the Equitable Advancement of Rural Livelihood, to facilitate their promotion and marketing to development partners and funding agencies.

**Table 8.** Summary of Land Cover

<b>SUMMARY OF LAND COVER</b>						
<b>PROGRAM FOR EQUITABLE ADVANCEMENT and RURAL LIVELIHOODS</b>						
LOCATION	AREA (HECTARES)					
	PRIMARY FOREST above and below 1,000 meters above sea level	SECONDARY FOREST with 40% to 60% tree cover	TOTAL EXISTING FOREST (Primary Forest + 50% of Secondary Forest)	GRASSLAND/ SHRUBLAND/ Other Land with Tree Cover (Less than 20% Tree Cover)	TOTAL	PROSPECT AREA FOR TREE PLANTING (50% of Secondary Forest + Total Grassland/Shrubland/ Other land with tree cover)
PEARL 1 - KITANGLAD RANGE	36,596.00	1,944.00	37,568.00	12,144.00	50,684.00	13,116.00
PEARL 2 - BUMBARAN RANGE	9,497.00	1,221.00	10,107.50	3,058.00	13,776.00	3,668.50
PEARL 3 - MT. KALATUNGAN	22,100.00	938.00	22,569.00	7,731.00	30,769.00	8,200.00
PEARL 4 - PANTARON RANGE	39,896.00	3,805.00	41,698.50	7,349.00	50,850.00	9,151.50
PEARL 5 - WAO RANGE	6,332.00	1,831.00	7,247.50	3,062.00	11,225.00	3,977.50
PEARL 6 - MATIGSALOG RANGE	15,674.00	5,700.00	18,524.00	3,098.00	24,472.00	5,948.00
<b>TOTAL</b>	<b>130,095.00</b>	<b>15,239.00</b>	<b>137,714.50</b>	<b>36,442.00</b>	<b>181,776.00</b>	<b>44,061.50</b>
As of 2009	Maximum	Maximum		Minimum		

**RATIO IS**

**TO PROTECT THE  
EXISTING  
137,715 hectares**

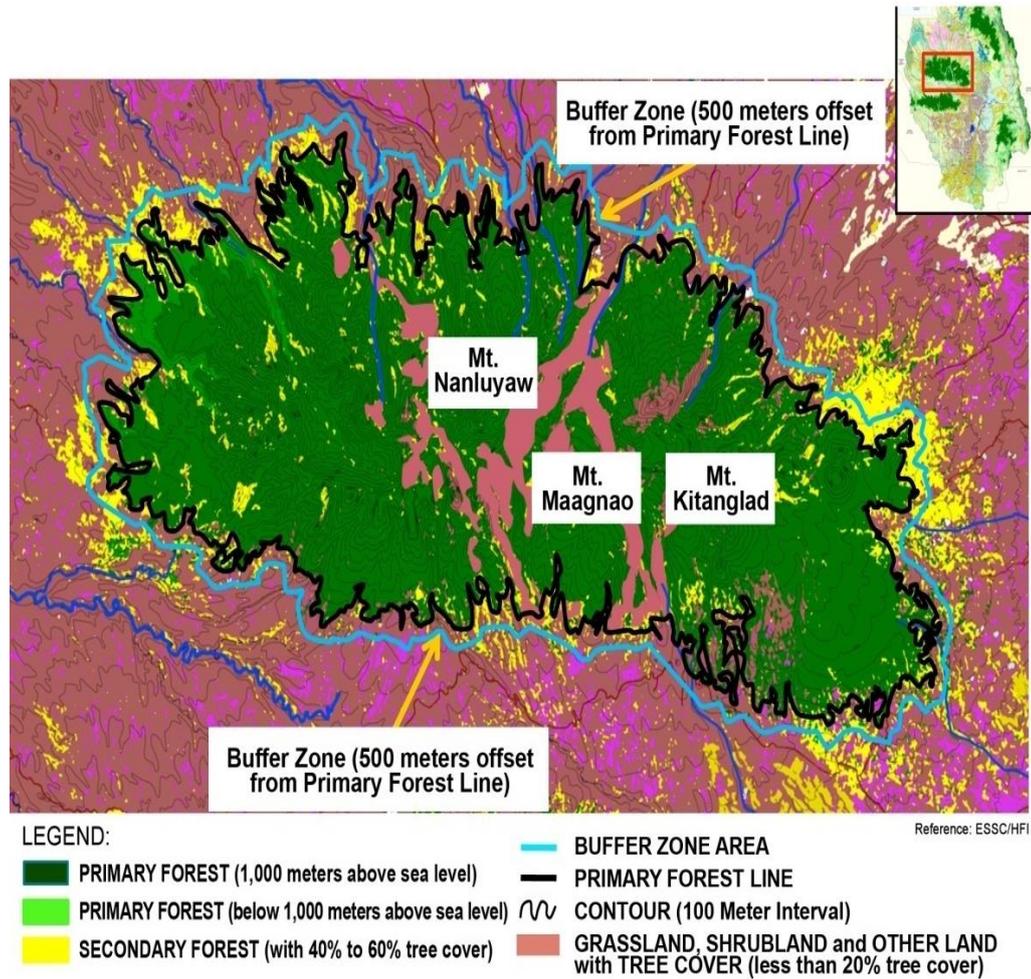
**1 has. Planted  
= 3 has. protected**

**WE PLANT TREES ON  
44,062 hectares**

Source: Hineleban Foundation, Inc.

Among these six zones, the one in the Kitanglad mountain range can be considered as the topmost priority. It is the most accessible and offers the greatest chance of success due to ongoing conservation and management efforts by surrounding communities, nongovernment organizations and the local government units. Figure 33 below shows the Kitanglad buffer zone of 500 meters that is needed to insulate the inner areas from further deprecations.

**Figure 33.** Kitanglad Range Protected and Buffer Zone Area



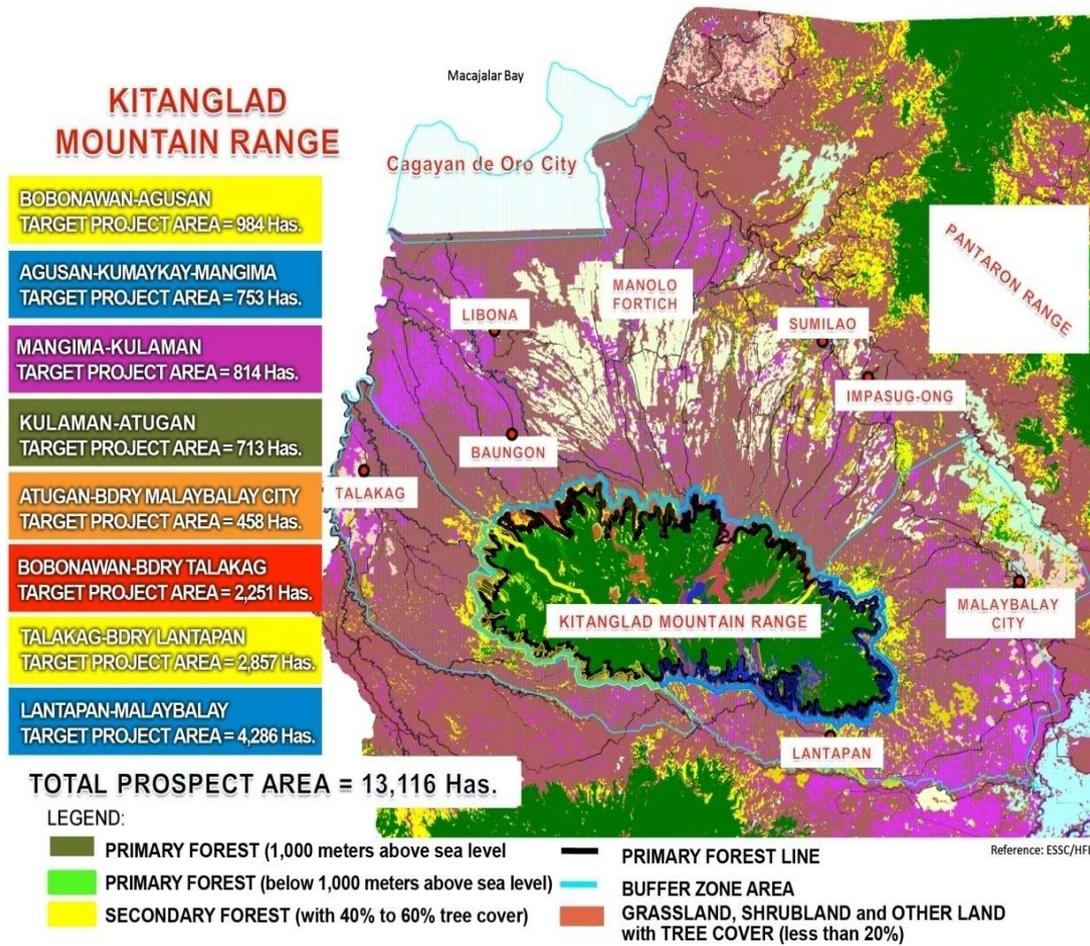
Source: Environmental Science for Social Change, 2009

Figure 34 below shows the specific areas in the vicinity of the Kitanglad mountain range that may be developed for food production that will provide income to the communities and therefore inhibit dependence on forest resources for livelihood. This is where the “commercial planting” component of the reforestation program will take place. There are 10 buffer zone communities in this zone, with 191 households composed mostly of the Bukidnon, Higaonon and Talaandig tribes and some migrants. The colored areas inside the zone are the denuded parts of the mountain range watershed which need to be rehabilitated and

rainforested. These are the areas that require “permanent planting,” wherein the rainforested species must remain in-situ to stabilize and regenerate the ecosystem. As shown in Figure 34 below, a total prospective area of 13,116 hectares of areas in severely denuded and require rainforestation on a total of 8 ridges of the Mt. Kitanglad range.

This exercise of demarcating the ridges is very useful as it also identifies who gains the most from using waters generated by the watershed in these upper river basins of Mt. Kitanglad. As such, one can target water users for implementing payments for environmental service schemes including from private sector corporations who are primarily engaged in agriculture and food production. The same exercise has been undertaken for all six zones chosen to be the geographic domain of this research.

**Figure 34.** Watershed Service Area for Food Production

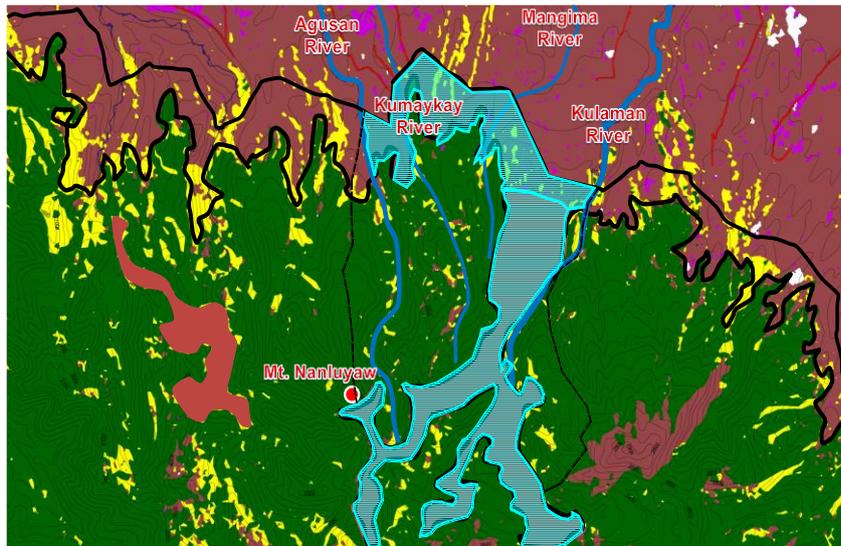


Source: Environmental Science for Social Change, 2009

Figure 35 below illustrates the estimation of denuded areas taking into account two of the ridges of Mt. Kitanglad. It shows a portion of the Kitanglad Mt. Range with the critical headwaters of the rivers that flow from the area. The river systems that emanate from this part include the Agusan, Kumaykay, Mangima and Kulaman rivers.

This specific part of the zone in the Kitanglad Mt. Range is also an example that shows denudation occurring inside the zone (shown in brown and yellow colors). This is the area that requires immediate rehabilitation with permanent planting of indigenous and other tree species to stabilize and regenerate the soil and ecosystem.

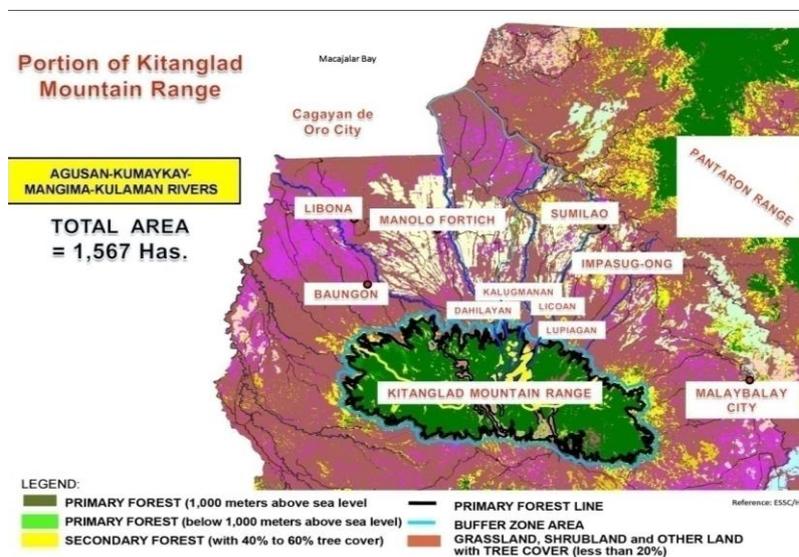
**Figure 35.**Critical Headwaters of Rivers from Kitanglad



Source: Environmental Science for Social Change, 2009

Figure 36 below shows the surrounding towns and regional center (Cagayan de Oro City) that these rivers serve. The total area shown in color yellow (amounting to some 1,567 hectares) is the one that on one side of two of the ridges of Mt. Kitanglad is severely denuded and is in urgent need of reforestation.

**Figure 36.** Kitanglad Mountain Range with Surrounding Towns and Cities



Source: Environmental Science for Social Change, 2009

#### 4.6 Government agencies, policies and laws to manage water resources

There is an entire assortment of national and local government agencies tasked with varying degrees of responsibility for the monitoring, development, management and use of the country's water resources.

Table 9 is an illustration of the Philippine water resources monitoring and development system, which includes watershed management led by the National Water Resources Board.

**Table 9.** Water Resources Monitoring and Development Agencies

<b>Government Agency</b>	<b>Responsibility</b>
PAGASA	Monitoring, data gathering, and maintenance of information on rainfall and evaporation.
Bureau of Research and Standards of DPWH	Monitoring and studies of water resources, water research and quality standards, flood control.
National Power Corporation	Water resources monitoring, research and hydropower generation
National Irrigation Administration of DA	Development, operation, and maintenance of irrigation systems
Bureau of Soils and Water Management of DA	Handles construction and management of SWIM projects.
NWRB	Coordinates in irrigation, hydropower, flood control, navigation, pollution, water supply, waste disposal, watershed management, among others.
MWSS of DPWH	Responsible for water supply,

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	storage, treatment, research, design, construction, and maintenance of water supply and sewage systems in NCR and nearby provinces.
Local Water Utilities Administration of DPWH	Responsible for development and improvement of water and sewerage systems in areas not covered by MWSS.
DENR	Forest, protected areas and wildlife management, land management and mines development.

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In reality, however, there is no coherent system of watershed management. Rola and Francisco (1999) observe that the country's 16 administrative regions "are not congruent with the water resources regions. As such, there is no administrative unit that manages the water resource regions. The operationalization of planning at the water resource regions thus remains elusive, at best a plan."<sup>59</sup>

Elazegui (1999) similarly comments that there is not only lack of coordination between agencies, there is also lack of coordination *within* (underscoring supplied) agencies themselves: "...there is no clear coordination between the NWRB and DENR in implementing their respective programs except the fact that the DENR sits as a member of the NWRB Board. Within DENR, there is no explicit coordination between the FMB, which deals with forest management activities, and the EMB, which is responsible for the country's Environmental Impact Assessment System. Even in water quality monitoring, there is apparently

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<sup>59</sup>Rola, A. C. and Francisco, H. A. (2004). Toward a win-win water management approach in the Philippines. In Rola, A. C., Francisco, H. A. and Liguton, J. P. T. (Eds.) *Winning the Water War*. Makati City: PIDS and PCARRD. pp. 4-5.

no coordination of activities, and coherence of methodologies and standards among agencies involved, as in the case of the DENR-EMB and the DOH.”<sup>60</sup>

There is a plethora of policies and laws that pertain to forest resources and watershed management. But what are needed are clear institutional arrangements that work. Cruz (1999) comments: “Political, institutional and sectoral boundaries will have to be crossed if not obliterated in order to promote greater and lasting collaboration between and among LGUs, institutions, agencies and sectors that often have competing and conflicting interests in the watershed. The challenge will be on how to develop arrangements where the sharing of benefits and responsibilities is acceptable to all parties.”<sup>61</sup>

**Table 10.** Relevant Orders and Laws Pertaining to Watershed Management

Administrative/Executive Order/Title	Purpose
DENR Admin Order 92-30	Identifies specific functions of DENR and projects to be devolved to the LGUs for each of the sectors: forest management, protected areas and wildlife management, land management and mines development.
DENR –DILG Joint Memo Circular No. 98-01 (partnership between LGUS and the DENR in forest management is anchored on the Local Gov’t Code and DENR AO No. 30, Series of 1992).	Creation of a National Steering Committee to formulate policies and programs toward strengthening and institutionalizing the DENR-DILG-LGU partnership on devolved and other forest management functions.

<sup>60</sup>Elazegui, D. D. (2004). Water resource governance: realities and challenges in the Philippines. In Rola, A. C., Francisco, H. A. and Liguton, J. P. T. (Eds.) *Winning the Water War*. Makati City: PIDS and PCARRD. p. 95.

<sup>61</sup>Cruz, R. V. O. (1999). Appendix Highlights of the Policy Forum on Water Resource Management. In Rola, A. C., Francisco, H. A. and Liguton, J. P. T. (Eds.) *Winning the Water War*. Makati City: PIDS and PCARRD. p. 252.

Executive Order No. 192	Created the Forest Management Bureau which would absorb the powers and functions of the Bureau of Forest Development and the Wood Industry Development Authority.
Presidential Decree 705 – Revised Forestry Code of the Philippines (1975)	Assigns the DENR to study, revise, determine and prescribe the criteria, guidelines, and methods for the proper and accurate classification and survey of all lands of the public domain into agricultural, industrial or commercial, residential, resettlement, mineral, timber or forest, and grazing lands and other classes.
<i>Table 11 cont.</i>	
DENR Administrative Order No. 99-01	Adopts the Watershed and Ecosystem Planning Framework; review and realign all programs and projects, including budgets, in accordance with the priority watershed areas of the regions.
DENR Administrative Order No. 95-15	Revised general guidelines in the implementation of the Sub-classification of Forestlands and other Inalienable Lands of the Public Domain; defines the various forestland classification categories and criteria that will be used for classifications; describes the procedures for the survey, zoning and mapping, processing and approval of the sub-classification
DENR Administrative Order No. 98-41 DENR Memo Circular No. 98-08	Provides guidelines on the establishment and management of Community-Based Forest Management (CBFM) projects within Watershed Reservations.
DENR Administrative Order No. 99-53	Provides regulations governing the Industrial Forest Management Program
RA 8371 – An act to recognize, protect and promote the rights of IPs,	Recognizes the applicability of customary laws governing property

establishing implementing mechanisms, appropriating funds therefore and for other purposes (1997)	rights or relations in determining the ownership and extent of ancestral domain.
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Table 10 above presents the relevant DENR administrative, executive orders and circulars pertaining to watershed management. The most important in the list is DENR Administrative Order No. 99-01 which adopts the watershed and ecosystem planning framework; and mandates the review and realignment of all programs and projects, including budgets, in accordance with the priority watershed areas of the regions.

The devolution of some DENR functions and responsibilities to the local governments like forest management, protected areas and wildlife management, land management and mines development was followed by a strengthening program between DENR and DILG through Joint Memo Circular No. 98-01.

Presidential Decree 705 assigns the DENR to study, revise, determine and prescribe the criteria, guidelines, and methods for the proper and accurate classification and survey of all lands of the public domain into agricultural, industrial or commercial, residential, resettlement, mineral, timber or forest, and grazing lands and other classes. This decree is important in the management and protection of the watersheds, its tributaries, the forests around it, the waterways including rivers, swamps, agricultural lands and the communities around it.

The rest of the DENR circulars pertain to the management of industrial and community forests which include surveying and reclassifying of forest lands. (See

Appendix A for comprehensive list of forestry and watershed laws, with accompanying descriptions.)

The strategic approach will therefore not start from scratch. Much of the government infrastructure and the legislation to help make it work are in place. Many of the laws and executive orders promote community-based forest management (CBFM) and emphasize the enforcement and monitoring role of local governments.

Nonetheless, there is a need for rationalization and coherence in the policy and legislative environment. Many policies are not supported by the corresponding legislation and are hostage to the periodic changes in political administrations. Many policies in fact prescribe onerous requirements that discourage private sector participation.

Speaking of industrial tree plantations, the ADB (2001) reports that “Private corporate sector involvement is still constrained by ‘unbankable’ rules and regulations, such as restrictions on cutting of trees planted because of proximity to naturally regenerated species. Frequent changes in rules and regulations have led to difficulties in interpretation and some governance problems.”<sup>62</sup>

What is needed is the integration of the strategic approach that will make sure that there is clear coordination among agencies and other stakeholders

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<sup>62</sup> Asian Development Bank (2001 December). *Program Performance Audit Report on the Forestry Sector Program (Loans 889[SF]/890-PHI) in the Philippines*, p. 22.

involved and that the appropriate laws and policies are in place to support the objectives of the reforestation program.

#### 4.7 Sampling of Successful Strategies

The strategic approach can also draw from the rich experiences of many international and local organizations. Table 11 shows a sampling of strategies of various organizations to mitigate negative environmental impacts.

**Table 11.** Sample of Strategies of Different Organizations

<b>Impact</b>	<b>Strategy</b>	<b>Organization</b>	<b>Country</b>	<b>Source</b>
Climate change due to excessive runoffs	Provide specific adaptation strategies to link existing stormwater management efforts to climate change initiatives.	Association of Watershed and Stormwater Professionals	USA	Watershed Science Bulletin 2011
Deforestation, climate change, lung disease	Use of innovative, efficient brick stove that reduced fuelwood consumption and smoke emission	Alliance for International Reforestation, Inc. (USA)	Guatemala	
Deforestation	Payment for environmental services	Government of China	China	The Economist
Deforestation,	Payment for environmental	Government of	Costa Rica	Bank of Natural

climate change	services, policy reform	Costa Rica		Capital web site
Environment degradation	Interagency partnerships creating a comprehensive and synergistic work on the management of the environment.	DENR-DILG-LGUs	Philippines	
<i>Table 12 cont.</i>				
Environment degradation	National greening programs, water conservation health advocacy, strong public-private partnerships	LWUA	Philippines	LWUA website
Environment degradation	Established its own watershed mgmt. dept.; educates communities to better manage forests, agricultural lands, increasing crop yields and converting waste by products into useful items	National Power Corporation	Philippines	NPC website
Deforestation Degradation of Pulangi Watershed	Plant any tree species in any open land and along sloping areas, creeks,	Municipal governments of Quezon and Pulangi in Bukidnon	Philippines	

	streams and rivers.		
Denudation of forests	Low cost dissemination of agro-forestry practices and political will in mobilizing the community for the project.	International Center for Research in Agroforestry	Philippines
<i>Table 12 cont.</i>			
Degradation of forests	A community-based forest management model for watershed management and protection; educates members in forestry management.	The NGAN Panansalan Pagsabangan Forest Resource Development Cooperative	Philippines

Notable in this short list are the highly successful implementation of payment for environmental services in China and Costa Rica; the local projects initiated by the Bukidnon municipalities of Quezon and Pulangi, and the NGAN Panansalan Pagsabangan Forest Resource Development Cooperative.

“China has one of the world’s biggest PES schemes, a decade-old reforestation effort that has delivered nine million hectares of new forest. Launched in response to flooding of the Yangzi river, it involves paying farmers \$450 a year per reforested hectare. Costa Rica is another PES trailblazer. Since 1997 it has made payments of \$45-163 a hectare to encourage forest conservation, planting and

agroforestry. The money comes from a hydroelectric company that is keen to protect its watershed; the World Bank, which reckons Costa Rica's biodiversity is a global good; and a 15% surcharge on petrol. The country's deforestation rate is now negligible."<sup>63</sup>

Costa Rica is considered a model country for PES. It is reaping the benefits of a sustainable, balanced ecosystem with its population ranking "first in having the highest satisfaction in life, longest life expectancy and lowest ecological footprint."<sup>64</sup>

From 1997 to 2004, Costa Rica initially invested US\$200 million to pay forest owners to conserve their forests instead of cutting trees and turning them into low-income pastureland. The program initially conserved more than 460,000 hectares of trees and in 2005 covered about 10% of Costa Rican forestland. Through its PES scheme, Costa Rica has given clear monetary value to its forests and has made its people keenly aware of the value of Nature.

Many other projects and experiences, local and international, from which valuable lessons can be drawn may be cited.

A successful reforestation project in Sorsogon involves schoolchildren: They plant and adopt the tree until they graduate from elementary school. Upon graduation, the children are given recognition and awards. In Davao City, a reforestation project organized a community and taught them communication skills

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<sup>63</sup>Astill, James (2010, September 25). Seeing the wood. A special report by *The Economist*.p.7.

<sup>64</sup>Borromeo, Katrina (2010, October 5). Costa Rica: A poster-child for PES. *Bank of Natural Capital*. Retrieved from <http://bankofnaturalcapital.com/2010/10/05/costa-rica-and-payments-for-ecosystem-services/>

and whom to approach to express their community's need for water, electricity and road improvement. Even after the project ended, the community sustained its activities and received the utilities it worked for: water, electricity and a road improvement project care of DPWH. The key to the project's success was the participation, commitment and unity of the barangay leaders.

There is no shortage of strategies and approaches by various groups to manage and conserve our watersheds. What is lacking is an integrated, long-term, sustainable, upper river basins focus. This is what the strategic approach addresses.

#### **4.8 Watershed Management through the Strategic Approach**

Cruz (1999) enumerates the general and specific objectives of watershed management:

The general objective of watershed management is the sustainable production of goods and services demanded by society without adversely affecting the sustainability of soil and water resources. Specifically, most watershed management activities are directed towards the following:

1. Stream flow regulations for adequate quantity, quality and favorable flow patterns;
2. Conservation of the soil resources for long-term productivity;
3. Enhancement of infiltration capacity of the soil;
4. Soil erosion minimization;
5. Optimum production of various combinations of goods and services;
6. Eradication of the pervasive poverty in the uplands; and
7. Environmental stabilization (climate change mitigation).<sup>65</sup>

Based on the Strategic Approach Pyramid, the program to manage and conserve selected critical watersheds in Bukidnon and Lanao del Sur will have the following features:

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<sup>65</sup> Cruz, R. V. O. (1999). Integrated Land Use Planning and Sustainable Water Management. *Journal of Philippine Development*, 47(26), p. 30.

- Rainforestation of the upper river basins of the six watersheds;
- Use of Calliandra or similar fast-growing tree species such as ipil-ipil to prevent the growth of cogon and talahib that are the source of wild grass fires and which have made the re-introduction of native tree species impossible on steep mountain slopes;
- Development of long-term livelihood program to augment income sources for forest and buffer zone communities and ensure sustainability;
- Strong program ownership, support and involvement of all stakeholders: national and local governments, private companies and businesses, nongovernment organizations, donor countries and agencies, communities and indigenous peoples;
- Use of a geographic information system for mapping, pinpointing of problem areas and project monitoring;
- High return on investment, with a ratio of three hectares to be protected for every hectare actually planted and grown;
- Payment for environmental services by downstream water users to encourage upland forest communities to conserve the watershed forests.

To effectively implement the strategic approach, it is essential to first characterize the watersheds and from this information database, plan its implementation by identifying problems, and the opportunities and methods that will lead to solving these problems. Watershed characterization was carried out through the geographic information survey, site visits, interviews and consultations, and online and library research. More than a physical characterization, the strategic

approach has identified a host of political, legal, social, cultural and economic considerations that dictate its direction and shape if it is to be truly strategic and effective.

To aid in management planning, a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis will go a long way towards identifying problems and possible solutions. The following is an initial SWOT Analysis of the strategic approach to manage and conserve selected watersheds in Bukidnon and Lanao del Sur. See Table 12 below.

**Table 12.** SWOT Analysis of Strategic Approach

*Internal*

<b>STRENGTHS</b>	<b>WEAKNESSES</b>
1. Clear vision of rainforestation objectives.	1. Inadequate internal communication among stakeholders.
2. Technical expertise of forestry experts and other personnel.	2. Personnel turnover.
3. Track record in experimental and “pilot-level” rainforestation programs.	3. Minimal experience in large-scale rainforestation projects.
4. Strong local government ownership and support.	4. Political rivalries and infighting.
5. Long association with potential donor agencies.	5. High cost and extended project life may discourage long-term financial support.
6. Proven method to combat and eliminate cogon and talahib: The use of calliandra or similar fast-growing tree species that will prepare the soil for eventual regeneration of permanent, native tree species.	6. Objections to the introduction of calliandra in protected areas because it is a nonindigenous tree species.

7. Expertise in modern information technologies to aid in project mapping, planning, monitoring and advocacy.	7. Lack of enough information technology and communication personnel.
8. Buffer zone system wherein forest communities may engage in sustainable livelihood activities.	8. Lack of infrastructure to market produce.
<i>Table 13 cont.</i> 9. Long track record in working with indigenous peoples.	9. Inability to prevent the incursions of non-IPs and lowlanders weakens the bonds of trust developed over the years.
10. High awareness of soil conservation measures, sound forestry methods and need for preservation of biodiversity among forest communities.	10. Temptation to extract forest resources without regard for sustainability remains very strong, especially among the kaingineros.
11. Long track record in sustainable agriculture.	11. Lack of irrigation facilities diminish productivity and discourage sustainable agriculture.
12. Expertise in project management and values education among watershed stakeholders, particularly the forest communities.	12. Lack of replication in farm households diminishes capacity building, especially among the younger farmers.

### *External*

<b>OPPORTUNITIES</b>	<b>THREATS</b>
1. Heightened awareness of need for rainforestation among stakeholders and community, triggered by Sendong.	1. “Blame game” may sabotage bonds of cooperation among stakeholders.
2. Existing legislation and other government policies mandating watershed management and conservation.	2. Overlapping and conflicting provisions; lack of enforcement.
3. Existing government agencies and administrative infrastructure to	3. Corruption, lack of resources and lack of political will to enforce

enforce water, land use and forestry laws.	water, land use and forestry laws.
4. Local government units have power to legislate and enforce water, land use and forestry policies.	4. Local government units do not have enough resources to enforce water, land use and forestry policies.
5. Multistakeholder nature of watershed management and conservation engenders formation of broad rainforestation coalition.	5. Conflicting vested interests may pose impediments to the formation of a broad rainforestation coalition.
<i>Table 13 cont.</i> 6. Relative inaccessibility of upper river basins make them easier to protect.	6. Rapid population growth puts increasing pressure on rapidly dwindling forest resources.
7. Strong tenurial instruments such as certificates of ancestral domain claims and community-based forest management agreements help in the preservation of forestlands.	7. Business interests keen on forestland conversion for residential, recreational or commercial/ecotourism purposes.
8. National Greening Program currently funded and spearheaded by National Government.	8. Inadequate attention on rainforestation in upper river basins, inadequate provision for nurturing of trees to maturity and for project sustainability.
9. Potential revenue from payment for environmental services scheme shall help sustain watershed management and conservation.	9. Difficulties in rationalized valuation, collection, and disbursement to actually benefit forest communities.
10. High levels of confidence and sympathy from international donor community.	10. High project cost due to long-term sustainability and livelihood components.
11. Expanded window of opportunity to implement rainforestation program due to higher awareness of need to mitigate ill effects of climate change.	11. Accelerated climate change, leading to increased vulnerability to natural calamities.

For change to take effect and to be permanent, it has to be properly managed. The application of Kotter's eight phases of change<sup>66</sup> will be a very useful management tool to guide the implementation of the strategic approach.

## **Application of Kotter's Eight Phases of Change to Strategic Approach to Manage and Conserve Selected Mindanao Watersheds**

### ***1. Establish a sense of urgency***

The sense of urgency to manage and conserve the selected watersheds in Bukidnon and Lanao del Sur is very high, as evidenced by the very recent devastation wrought by Sendong. What is needed is to sharpen this sense of urgency to focus on the need to conduct rainforestation in the upper river basins where they will have the greatest impact on the hydrological cycle instead of just a loose National Greening Program that has no such focus.

### ***2. Create a coalition***

The series of consultations and meetings that have brought the urgent message of rainforestation in the upper river basins to the attention of a wide range of stakeholders – from senators and cabinet secretaries to local government officials to forest communities of indigenous people, has laid the basis for a broad coalition of enlightened stakeholders that will push and move the program forward.

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<sup>66</sup>Kotter's 8-Step Change Model (n.d.). *Mind Tools*. Retrieved from [www.mindtools.com/pages/article/newPPM\\_82.htm](http://www.mindtools.com/pages/article/newPPM_82.htm)

#### ***4. Develop a clear vision***

The spirit and ultimate goal of the watershed management and conservation program shall be summed up in the compound word “rainforestation.” The words “rain” and “reforestation” shall be inextricably linked and the meaning crystallized for everyone to understand, from the highest government officials to the less educated forest dwellers in the program areas.

#### ***5. Share the vision***

Every avenue of advocacy and communication shall be used constantly to bring home the message and the vision of rainforestation. Every stakeholder, every forest community household, shall be the target of the appropriate message packaged in the most appropriate medium of communication to reach that target audience. Guided by the vision of rainforestation, no stakeholder will falter, no stakeholder will fail to act.

#### ***6. Empower people to clear obstacles***

Every group of stakeholders shall be motivated, trained and equipped to face challenges and contribute to the achievement of the vision of rainforestation. For example, a key component of the program to achieve sustainability is the provision of long-term livelihood opportunities to the forest communities in the buffer zones. To ensure this, they shall be trained in, among other things, sloping land agriculture techniques, soil conservation, the appropriate crops to plant for their elevation, food processing, etc. Having been motivated and trained, they shall be provided the resources, such as land, farm inputs and equipment to be productive and put their training to actual use. At the same time, they shall be organized to protect and

advocate their interests and the goal of reforestation. Thus, the training, productivity and organization shall serve to empower this particular sector to face whatever obstacles may arise on the long road to reforestation.

### ***7. Secure short-term wins***

By its nature – the need to nurture native tree species to full growth and maturity – reforestation will be a long 10- to 15-year program. The target zones also encompass a large area of forbidding terrain. Thus, it is essential to have short- and medium-term benchmarks of success. For example, the successful use of calliandra to combat and eliminate cogon and talahib shall be a very important short-term win in the process of reestablishing the soil for the assured survival of reintroduced native tree species.

### ***8. Consolidate and keep moving***

A series of short-term wins will amount to a sum total of successes that will strengthen the core of the program and give it the momentum to move forward at a faster pace. For example, the program needs to start with priority areas that will assure it of initial successes which shall be the foundation of wider and bigger successes. One of these priority areas is the Kitanglad Mountain Range due to its accessibility, its designation as a protected area, and the various past and ongoing efforts of different organizations and communities to protect and manage its watershed.

### ***9. Anchor***

The ultimate success of the program is for it to take root, quite literally and figuratively, and make the change permanent. The sustainability will rely on the effectiveness of long-term livelihood programs, the successful reintroduction of native tree species, and the success of measures such as the scheme for the payment of environmental services by all downstream users and stakeholders. Without these anchors, the rainforestation program will just be washed away, once more, into the sea.

### **Management Strategy: Think National, Act Local, Impact Global**

We face a daunting task involving many complex issues, owing to the multisectoral and multidimensional nature of the crisis our watershed ecosystems are in. But global climate change is upon us and this is our last fighting chance. “Think national, act local, impact global” summarizes the strategic approach that will stop our watersheds’ literal slide down the slippery slope of overexploitation and mismanagement.

“Think national” because legislation, planning and funding must be comprehensive, coherent and long-term. A clear change in mindset to treat watershed management as an integrated ecosystem independent of political boundaries that has multiple stakeholders; and the valuation of increasingly scarce natural resources like water as no longer “free” must seep into the national consciousness.

“Act local” because conditions and cultures on the ground vary and this is the arena of implementation that determines who gets what done where, when and how.

Local governments have the power to legislate and enforce at the same time, and transparency may be easier achieved at the local level, where people's organizations can monitor and clearly determine if funds are actually spent for their intended purpose. Local communities also largely determine the success or failure of any project in their area.

“Impact global” is the spider web of the entire ecosystem, where any disturbance or impact, positive or negative, on any strand is felt in the entire watershed, the entire worldwide web of life.

## **CHAPTER 5**

### **SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

This chapter presents the study's summary of findings, conclusions and recommendations.

#### **5.1 Summary of Findings**

This study sought to arrive at a comprehensive picture of the Philippine watershed ecosystem in crisis and formulate a strategic approach to its management and conservation, particularly in selected mountain ranges in Bukidnon and Lanao del Sur in Mindanao.

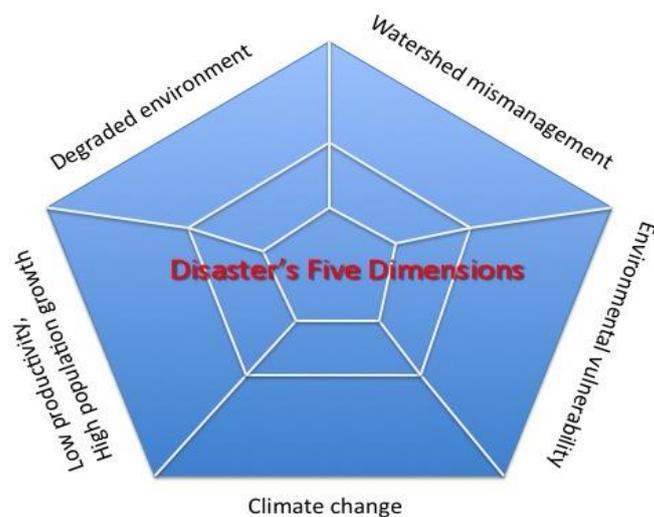
This is a descriptive study that drew data from published and online sources, particularly technical studies, reports and presentations; unstructured interviews, consultations and meetings with various stakeholders, including national and local government officials, legislators, scientists, farmers, environmentalists, nongovernment and peoples' organizations, tribal leaders and indigenous people; and a geographic information system survey for mapping, validated by field visits, observation and photographic documentation. Data gathering was done for over three years.

Below are the sub-problems and issues that were answered or discussed by this research:

- a. What is the status of the problem area in terms of:
  - a.1. Geographical features of the country and its watersheds;

- a.2. State of environment of the area;
- a.3.State of watershed management; and
- a.4. Environmental vulnerability risks?
- b. What is the impact of low productivity coupled with high population growth?
- c. What are the climate change impacts?
- d. What are the government agencies and laws to manage water resources; and
- e. Strategies and methodologies to sustainably manage and conserve the watersheds?
- f. What is watershed management through the strategic approach?

Data compiled added up to a compelling image of a multisectoral, multidimensional crisis besetting Philippine watershed ecosystems. This situation is represented by a pentagonal model that illustrates the five major dimensions of the Philippine watershed ecosystem crisis: a highly degraded environment, watershed mismanagement, environmental vulnerability, low productivity coupled with high population growth, all exacerbated by climate change. (Figure 1 is reproduced below for reference).



The model was dramatically validated by the typhoon Sendong-induced disaster that struck exactly the study area of Northern Mindanao in December 2011.

### ***Degraded environment***

The targeted Bukidnon and Lanao del Sur watersheds' environment is highly degraded. Almost total forest denudation and intensive farming, especially on sloping terrain, have led to severe soil erosion and siltation of waterways.

### ***Watershed mismanagement***

The lack of comprehensive planning on the basis of the entire watershed ecosystem as a planning and management unit (instead of political boundaries) has allowed uncoordinated and inadequate watershed management efforts to take place, leading to eventual failure, unsustainability and plain inability to enforce forestry laws in the face of uncontrolled natural resource extraction and competing interests of various watershed users and stakeholders.

### ***Environmental vulnerability***

The United Nations Environment Programme's Environmental Vulnerability Index rated the Philippines as "extremely vulnerable" based on 50 "smart indicators" classified under five categories, namely: weather and climate, geology, geography, resources and services, and human populations. Of the country's 11 EVI issues of greatest environmental vulnerability, eight were present in the Sendong disaster: wet periods, slides, loss of cover, degradation, intensive farming, population density, population growth, and coastal settlements.

### ***Low productivity coupled with high population growth***

Soil erosion and erratic rainfall have severely affected agricultural and forestry productivity. In combination with a high population growth rate, low productivity has resulted in a country that cannot even feed itself and has to rely on food imports to have enough for its poor, hungry people.

At the same time, population pressure has resulted in more encroachments on the remaining forests in the uplands and the settlement of people on hazardous lowland areas, particularly along waterways and coastal areas.

### ***Climate change***

An estimated 20 million hectares or 67% of the country's total land area may be severely affected by climate change (Godilano 2010). These adverse events include droughts, floods and landslides – singly or in combination.

Climate change has resulted in erratic weather patterns and more intense and more frequent precipitation. Whereas Northern Mindanao is not in the typhoon

belt and is rarely visited by typhoons, this time Sendong gave the area a direct hit. The amount of precipitation was also unusual: 350 millimeters, a month's worth of rain, fell in less than 24 hours.

The calamitous Sendong event confirmed this study's original contention that the upper river basins of the watershed zones denoted by the six mountain ranges in Bukidnon and Lanao del Sur, namely: Kitanglad, Bumbaran, Kalatungan, Pantaron, Matigsalog and Wao, are strategic areas that must be reforested, conserved and properly managed. These watershed zones are the headwaters of rivers that run through six provinces and four regions of Mindanao. Owing to their central location, these watersheds provide the water requirements of the communities, farms, factories and hydropower plants in these provinces. However, the ecosystem of these watersheds is under grave threat from mismanagement and over-extraction of resources, exacerbated by climate change phenomena and other environmental hazards.

## 5.2 Conclusions

Mismanagement of the country's watersheds has allowed them to fall into varying states of degradation characterized by "severe soil erosion, erratic stream flow, diminishing groundwater resource, and declining land productivity" (Cruz, 1999).<sup>67</sup> In addition, there is loss of biodiversity and microclimate deterioration.

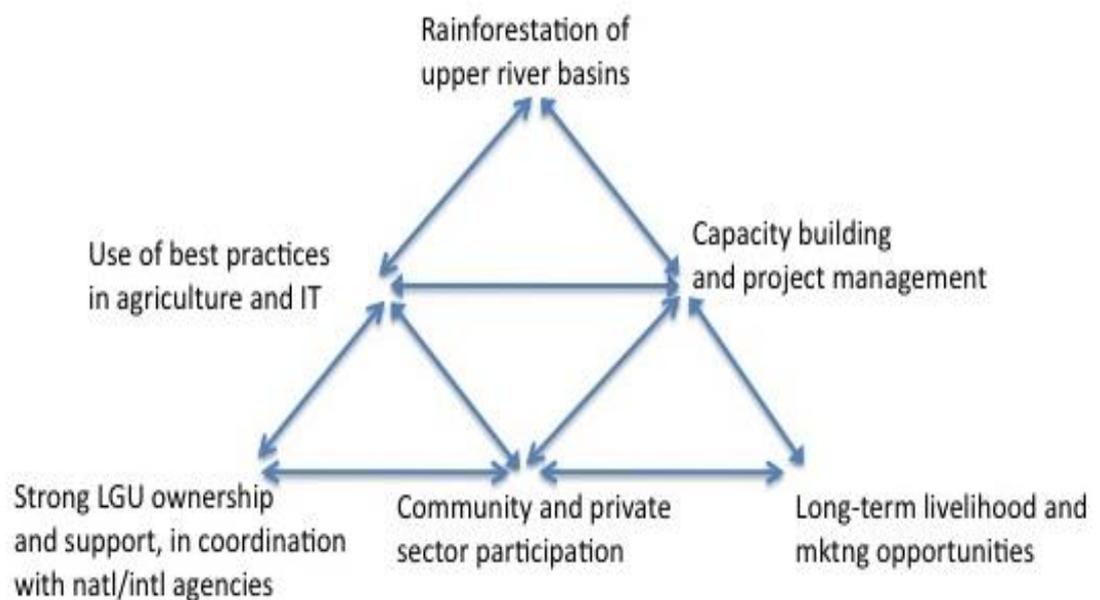
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<sup>67</sup> Cruz, R. V. O. (1999). Integrated Land Use Planning and Sustainable Water Management. *Journal of Philippine Development*, 47(26), p. 30.

It is imperative to institute a strategic approach to the management and conservation of these six watersheds that will ensure long-term availability of water for human consumption; agricultural, fisheries and industrial production; power generation and recreation; as well as to mitigate the ill effects of climate change that manifests itself in extended and more frequent episodes of the El Niño and La Niña phenomena; and reverse the environmental degradation that has resulted in landslides, massive soil erosion, siltation, and flooding in downstream communities.

The Strategic Approach Pyramid summarizes the key features that the conservation and management program must have in order to succeed: long-term, sustainable, integrated and literally takes the high ground – the upper river basins in the mountain ridges.

### Strategic Approach Pyramid



This strategic approach has the following specific features:

- Rainforestation of the upper river basins of the six watersheds;
- Use of Calliandra or similar fast-growing tree species to prevent the growth of Cogon and Talahib grasses that are the source of wild grass fires and which shall prepare the soil for the growth and long-term survival of re-introduced native tree species like lawaan;
- Development of long-term livelihood projects and income sources for forest and buffer zone communities to ensure sustainability;
- Strong program ownership, support and involvement of all stakeholders: national and local governments, private companies and businesses, nongovernment organizations, donor countries and agencies, communities and indigenous peoples;
- Use of a geographic information system for mapping, pinpointing of problem areas and monitoring;
- High return on investment, with a ratio of three hectares to be protected for every hectare actually planted and grown.
- The formulation of a strategic action plan, as shown below in Table 14, over the short-, medium-, and long-term with specific milestones to be achieved for each time period. It needs to be emphasized however that galvanizing the communities and mobilizing financial resources would be critical to efficient and effective implementation of the strategic action plan.

**Table 13.** Strategic Action Plan (15-year Time Horizon, 2020-2035)

Program for Equitable Advancement of Rural Livelihoods (PEARL)

Objective	Activity	Timeline	M & E Indicator	Stakeholders Involved
<b>A. IMMEDIATE/SHORT-TERM PLAN (2020 - 2024)</b>				
<p>1. To create public awareness of the established model rainforestation farm to showcase success and elicit funding support for a landscape reforestation of the 44,061.50 hectares (ha) target of PEARL</p> <p><i>Table 14 cont.</i></p>	<ul style="list-style-type: none"> <li>• Showcase model farm to policymakers and other stakeholders</li> <li>• Showcase denuded areas of the six mountain ranges in Bukidnon and Lanao del Sur through aerial viewing and photo documentation</li> <li>• Present PEARL program to potential partners and donors to financially support reforestation in denuded areas of the six mountain ranges</li> <li>• Develop information and communication strategies to advocate and inform public of model rainforestation</li> </ul>	<p>2020-2022</p> <p>2020-2022</p> <p>2020-2022</p> <p>2020-2022</p>	<ul style="list-style-type: none"> <li>• No. of policymakers and stakeholders that visited model farm.</li> <li>• No. of aerial viewing of denuded areas in the six mountain ranges</li> <li>• No. of presentations made and total commitment of funding support generated</li> <li>• No. of IEC strategies developed and disseminated for public awareness</li> </ul>	HFI
2. To reforest	• Kick off and	2021	• No. of	HFI, DENR,

<p>and rehabilitate the protected and buffer zone of the pilot sites in the following mountain ranges:</p> <ul style="list-style-type: none"> <li>• 81 ha in Sil-Ipon, Libona, Bukidnon</li> <li>• 81 ha in Bagalangit, ManoloFortich, Bukidnon</li> <li>• 200 ha in Lilingayon, Valencia City</li> <li>• 204 ha in Bumbaran, Lanao del Sur</li> <li>• 488 ha in Wao, Lanao del Sur</li> </ul> <p><i>Table 14 cont.</i></p>	<p>mobilization of communities through briefing and orientation</p>		<p>meetings and briefings made</p>	<p>NCIP, PLGU, MLGU</p>
	<ul style="list-style-type: none"> <li>• Delineation and demarcation of project boundaries</li> </ul>	2021	<ul style="list-style-type: none"> <li>• Report on delineation and demarcation</li> </ul>	<p>HFI, PO</p>
	<ul style="list-style-type: none"> <li>• Baseline survey and community mapping</li> </ul>	2021	<ul style="list-style-type: none"> <li>• Result of survey and community mapping</li> </ul>	<p>HFI, MLGU, BLGU, PO</p>
	<ul style="list-style-type: none"> <li>• Advocacy and communication campaigns</li> </ul>	2020-2024	<ul style="list-style-type: none"> <li>• IEC materials developed and disseminated</li> </ul>	<p>HFI, DENR, NCIP, PLGU, MLGU, PO</p>
	<ul style="list-style-type: none"> <li>• Capacity development and empowerment</li> </ul>	2020-2021	<ul style="list-style-type: none"> <li>• No. of trainings conducted and no. of people trained</li> </ul>	<p>HFI, DENR, DA,</p>
	<ul style="list-style-type: none"> <li>• Rehabilitation of 1,054 ha of denuded watersheds in five communities: <ul style="list-style-type: none"> <li>◦ Nursery establishment</li> <li>◦ Planting of seedlings</li> <li>◦ Fertilization</li> <li>◦ Maintenance</li> </ul> </li> </ul> <p>and Protection</p>	2020-2022	<ul style="list-style-type: none"> <li>• No. of seedlings produced per community</li> <li>• No. of seedlings planted per community and date of planting</li> <li>• Date of fertilization and type of fertilizer used</li> <li>• No. of persondays generated for forest maintenance and protection</li> </ul>	<p>HFI, PO</p>
	<ul style="list-style-type: none"> <li>• Monitoring and evaluation of pilot sites</li> </ul>	2020-2022	<ul style="list-style-type: none"> <li>• Report of annual field monitoring and assessment</li> </ul>	<p>HFI, DENR, PLGU, MLGU</p>

	<ul style="list-style-type: none"> <li>• Documentation of success stories in pilot sites</li> </ul>	2022	<ul style="list-style-type: none"> <li>• Database of success stories</li> <li>• Photo documentation of model rainforestation established in five communities</li> </ul>	HFI, PO
3. To develop and package proposals for scaling of reforestation in all six PEARLs	<ul style="list-style-type: none"> <li>• Continuous presentation of the PEARL program and lobbying to potential funding donors</li> <li>• Writing and packaging of proposals to scale up hectareage of reforestation</li> <li>• Submission of proposals to potential donors and funding institutions</li> </ul>	2020-2024	<ul style="list-style-type: none"> <li>• Documentation of presentations conducted</li> <li>• No. of proposals packaged and submitted to potential funding institutions</li> <li>• No. of proposals approved for funding to scale up rainforestation</li> </ul>	HFI
<i>Table 14 cont.</i>				
<b>B. MEDIUM-TERM PLAN (2025 - 2030)</b>				
4. To scale up reforestation of 2,000 denuded watersheds in the following mountain ranges;	<ul style="list-style-type: none"> <li>• Identification and demarcation of additional rainforestation sites</li> <li>• Consultation with stakeholders and potential PO partners</li> </ul>	2025	<ul style="list-style-type: none"> <li>No. of communities surveyed and profiled</li> <li>• No. of consultations conducted and PO partners identified</li> <li>• Reports of</li> </ul>	<p>HFI</p> <p>All stakeholders</p> <p>HFI</p> <p>HFI, DENR, NCIP, LGUs</p>

	<ul style="list-style-type: none"> <li>• Baseline survey and community mapping</li> <li>• Training and capability building of PO members</li> <li>• Consultations with stakeholders for payment of environmental services and develop mechanisms to implement PES</li> </ul>		<p>baseline survey and community profiling</p> <ul style="list-style-type: none"> <li>• No. of trainings conducted and no. of PO members capacitated</li> <li>• Concept on payment of environmental services introduced to stakeholders</li> </ul>	All stakeholders
• 500 ha in Lantapan (Pantaron range)	• Rehabilitation of 500 ha in Pantaron range	2025-2026	<ul style="list-style-type: none"> <li>• No. of seedlings produced</li> <li>• No. of trees grown</li> </ul>	HFI, PO
• 500 ha in San Fernando (Matigsalog Range) <i>Table 14 cont.</i>	• Rehabilitation of 500 ha in Matigsalog range		<ul style="list-style-type: none"> <li>• No. of seedlings produced</li> <li>• No. of trees grown</li> </ul>	HFI, PO
• 500 ha in Talakag (Kitanglad Range)	• Rehabilitation of 500 ha in Mt. Kitanglad range		<ul style="list-style-type: none"> <li>• No. of seedlings produced</li> <li>• No. of trees grown</li> </ul>	HFI, PO
• 500 ha in Bumbaran	• Rehabilitation of 500 of Bumbaran range		<ul style="list-style-type: none"> <li>• No. of seedlings produced</li> <li>• No. of trees grown</li> </ul>	HFI, PO
5. To enhance scaling up of reforestation of	• Delineation and demarcation of boundaries		2025-2030	<ul style="list-style-type: none"> <li>• No. of communities delineated</li> </ul>

<p>20,210 ha of denuded watersheds in five PEARLs</p> <p><i>Table 14 cont.</i></p>	<ul style="list-style-type: none"> <li>• Baseline survey and community mapping and profiling</li> <li>• Identification of PO partners</li> <li>• Consultation with policymakers, signing of contracts</li> <li>• Community organizing and empowerment of stakeholders</li> <li>• Provision of livelihood on coffee and bamboo production to IP beneficiaries in the buffer zone</li> <li>• Advocacy and public awareness activities</li> <li>• Documentation of success stories of rehabilitated watersheds</li> </ul>		<ul style="list-style-type: none"> <li>• Result of baseline survey and community mapping</li> <li>• Pos identified and with commitment</li> <li>• No. of contracts signed</li> <li>• No. of communities organized and operational</li> <li>• No. of IP beneficiaries provided with livelihood on coffee and bamboo production</li> <li>• No. of IEC materials delineated and disseminated</li> </ul>	
<ul style="list-style-type: none"> <li>• 12,454 ha in Mt. Kitanglad Range (PEARL 1)</li> </ul>	<ul style="list-style-type: none"> <li>• Rehabilitation of 12,254 ha of denuded watersheds Talakag, Baungon, ManoloFortich, Sumilao,</li> </ul>	2025-2026	<ul style="list-style-type: none"> <li>• No. of seedlings produced</li> <li>• No. of trees grown</li> </ul>	HFI, PO

	Impasug-ong, Malaybalay and Lantapan			
• 1,964 ha in Bumbaran Range (PEARL 2)	• Rehabilitation of 1,964 ha of denuded watersheds in Bumbaran	2026-2027	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 4,000 ha in Mt. Kalatungan Range	• Rehabilitation of 4,000 ha of denuded watersheds Pangantucan, Talakag, Maramag, Valencia City and Kalilangan	2027-2028	No. of seedlings produced  • No. of trees grown	HFI, PO
• 1,000 ha in Pantaron Range	• Rehabilitation of 1,000 ha of denuded watersheds in San Fernando and Quezon	2028-2029	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 792 ha in Wao Range	• Rehabilitation of 792 ha of denuded watersheds in Wao	2030	• No. of seedlings produced  • No. of trees grown	HFI, PO
<i>Table 14 cont.</i>  6.To develop database of success stories	• Documentary of success stories  • Photo documentation of rehabilitated watersheds in each mountain range  • Write-up of success stories in coffee and	2029-2030	• Documentary of success stories in CD formats  • Best practices packaged in presentation formats for various audiences  • Database of photo	HFI

	bamboo production  • Sharing of best practices in conventions, conferences and multimedia		documentary of rehabilitated mountain ranges  • No. of conventions and conferences attended to share best practices		
<b>C. LONG-TERM PLAN (2031 - 2035)</b>					
<i>Table 14 cont.</i>	7. To complete rehabilitation of denuded watersheds in the remaining 20,797.50 ha in the protected and buffer zone	• Consultation with policymakers and multi-lateral funding agencies	2031	• No. of meetings conducted with funding agencies  • No of contracts signed	ADB, AFD, MDA, JICA, WB
		• Delineation and demarcation of boundaries  • Baseline survey and community mapping and profiling  • Identification of PO partners		• Communities delineated  • Results of baseline and community mapping and profiling  • No. of POs identified; MOAs with POs signed	HFI, PO
		• Community organizing and empowerment of stakeholders	2032	• No. of communities organized  • No. of trainings conducted for beneficiaries	HFI, PO, PLGU, MLGU, BLGU
		• Provision of livelihood on coffee and	2032 - 2034	• No of IP households provided with	HFI, PO

	bamboo production to IP beneficiaries in the buffer zone		livelihood	
	• Advocacy and public awareness activities		• IEC materials produced and disseminated	HFI, DENR, NCIP, DILG, PO
• 1,000.50 ha in Bumbaran Range	• Reforestation and rehabilitation of 1,500.50 ha of denuded forests in Bumbaran	2031	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 4,000 ha in Mt. Kalatungan Range	• Reforestation and rehabilitation of 4,000 ha of denuded forest in Pangantucan, Maramag, Valencia City, Kalilangan and Talakag	2032	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 7,651.50 ha in Pantaron Range  <i>Table 14 cont.</i>	• Reforestation and rehabilitation of 7,651.50 ha denuded areas in San Fernando, Quezon and Valencia City	2033	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 2,697.50 ha in Wao Range	• Reforestation and rehabilitation of 2,697.50 ha of denuded forest areas in Wao range	2034	• No. of seedlings produced  • No. of trees grown	HFI, PO
• 5,448 ha in Matigsalog Range	• Reforestation and rehabilitation of 5,448 ha of denuded watershed	2034-2035	• No. of seedlings produced  • No. of trees grown	HFI, PO
8. To develop	• Documentary	2034-2035	• Documentary	HFI

database of success stories	of success stories <ul style="list-style-type: none"> <li>• Photo documentation of rehabilitated watersheds in each mountain range</li> <li>• Write up of success stories in coffee and bamboo production</li> <li>• Sharing of best practices in conventions, conferences and multimedia</li> </ul>		of success stories in CD formats <ul style="list-style-type: none"> <li>• Best practices packaged in presentation formats for various audiences</li> <li>• Database of photo documentary of rehabilitated mountain ranges</li> <li>• No. of conventions and conferences attended to share best practices</li> </ul>	
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### 5.3 Recommendations

The country's long experience in the mismanagement of its watersheds, its poor record in the sustainable implementation reforestation programs, and the dire watershed ecosystem crisis these have brought upon us sparked the formulation and design of the strategic approach to the management and conservation of our watersheds. The following key recommendations need to be observed in order to support and successfully implement the strategic approach:

- Take a holistic view of the watershed ecosystem as the basic planning and management unit, irrespective of political boundaries;

- Set out a longer-term “roadmap” or strategic action plan to guide all concerned, particularly local authorities and aid agencies and prevent opportunistic, piecemeal implementation of reforestation projects;
- Set priorities to guide its implementation. The top priority area for rainforestation should be the mountain ridges because this is where the greatest impact is in terms of rehabilitation of the ecosystem and avoidance of future disasters;
- Set up a technical working group within the provinces of Bukidnon and Lanao del Sur to define the roles and responsibilities of various agencies, coordinate between donor countries and agencies, monitor enforcement of the various laws and rules governing watershed management, and make sure that policy directives are in tune with the realities on the ground;
- Assure close relationship with the local communities by providing them appropriate and equitable incentives, as well as their strong sense of ownership for the project/program to help increase the chances of success;
- Issuance of policy directives should involve local governments and communities and not solely the national government to ensure ownership at the grassroots level;
- Legislation and implementing rules should be coherent, consistent, simple and enforceable.
- The authorities must consider reversing the prohibition against the use of calliandra in protected areas and initially allow experimental planting of

calliandra in about 20 hectares for the purpose of research and further demonstration;

- The National Greening Program recently launched by President Aquino must include mountainside planting and not just roadside and parks planting through an “enhanced NGP”;
- The “enhanced NGP” needs to recognize that “rainforestation” is essential to the preservation of the hydrological cycle and that the greater challenges posed by the re-introduction and conservation of native tree species on steep, denuded, low fertility, highly acidic, cogon-infested mountain slopes necessarily costs much more than a countryside greening program in the lowlands;
- Capacitate a local secretariat, such as the Bukidnon Watershed and Development Council to support and monitor implementation of rainforestation programs by the various stakeholders concerned;
- Gather data to assess the environmental vulnerability of Bukidnon, similar to the EVI formulated by the UNEP for the world’s countries, and use the analysis for mitigating against or adapting to future disasters;
- Ensure transparency and accountability (good governance) in the use of funds for rainforestation efforts and consider the downloading of such funds directly to the NGO and/or People’s Organization concerned who will implement the project/program with DENR or other agencies concerned providing oversight and policy guidance; and

- The Philippine Government's Medium-Term Development Plans at the regional levels must incorporate the essential elements of the strategic approach in designing future rainforestation programs in the country.

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**APPENDIX A**  
**CURRENT PHILIPPINE LAWS AND REGULATIONS GOVERNING**  
**WATERSHED MANAGEMENT**

**1.DENR ADMINISTRATIVE ORDER 92-30.** *Guidelines for the Transfer and Implementation of DENR Functions Devolved to Local Government Units.*

This order identifies specific DENR functions, programs, and projects to be devolved to LGUs for each of the sectors: forest management, protected areas and wildlife management, land management and mines development.

In forest management, the implementation of the following community-based forestry projects was devolved: ISF projects; establishment of new regular reforestation projects (except those areas located in protected areas and critical watersheds); completed family and community-based contract reforestation projects; Forest Land Management Agreements; and Community Forestry Projects.

Also devolved are the management and control of communal forests with an area not exceeding 50 square kilometers or 5,000 hectares; management, protection, rehabilitation and maintenance of small watershed areas that are sources of local water supply; enforcement of forest laws in community-based forestry project areas, small watershed areas and communal forests, including the apprehension of violators of forest laws, and the confiscation of illegally extracted forest products on site.

In addition to their Internal Revenue Allotment (IRA), LGUs are to allot funds for financing local development and livelihood projects, and for protecting and developing the environment and natural resources. These funds will come from LGUs' share of 40% of the gross collection derived by the national government from mining taxes, royalties, forestry charges and other taxes, fees, or charges enumerated in the Code.

The DENR shall transfer to the concerned LGUs the personnel and assets including pertinent records and equipment corresponding to the devolved functions.

**2.DENR-DILG JOINT MEMORANDUM CIRCULAR NO. 98-0.** *Manual of Procedures for DENR-DILG-LGU Partnership on Devolved and Other Forest Management Functions.*

This document indicates how to build an effective partnership between the LGUs and the DENR in forest management. The partnership is anchored on the Local Government Code and DENR Administrative Order No. 30, Series of 1992.

The salient provisions of the Circular are:

- Creation of a National Steering Committee to formulate policies and programs toward strengthening and institutionalizing the DENR-DILG-LGU partnership on devolved and other forest management functions. Regional Steering Committees will likewise be created to oversee and monitor the DENR-DILG-LGU partnership and to prepare a strategic plan which shall include, among others, joint land use planning,

resources sharing, and training for LGU capacity building on forest management.

- The appointment or designation of an Environment and Natural Resources Officer and the creation of an ENR Office in the LGUs shall be encouraged.”
- “Forest management projects (reforestation, communal forests, forest or tree parks, greenbelts) and functions devolved from the DENR (and personnel, equipment and other resources so transferred from the DENR) to the LGUs shall be fully documented and covered with a Memorandum of Agreement.
- The review and assessment of existing CBFM projects and the implementation of new CBFM projects shall be reviewed and assessed jointly.

**3.EXECUTIVE ORDER NO. 192.** *Providing for the Reorganization of the Department of Environment, Energy and Natural Resources, Renaming it as the Department of Environment and Natural Resources, and for other Purposes (1987).*

This Order mandates the DENR as the primary government agency responsible for the conservation, management, development, and proper use of the country’s environment and natural resources, specifically forest and grazing lands of the public domain, as well as the licensing and regulation of all natural resources.

This EO created the Forest Management Bureau (FMB), which would absorb the powers and functions of the Bureau of Forest Development (BFD) and the Wood Industry Development Authority (WIDA). The FMB shall advise the Secretary on matters pertaining to forest development and conservation. The EO also created a Protected Areas and Wildlife Bureau (PAWB) to take over wildlife and marine parks of the BFD, all national parks, wildlife sanctuaries, and game preserves previously managed by the Ministry of Human Settlements and national parks reservations.

**4.PRESIDENTIAL DECREE 705.** *Revised Forestry Code of the Philippines (1975).*

This Decree assigns the Department to study, devise, determine, and prescribe the criteria, guidelines, and methods for the proper and accurate classification and survey of all lands of the public domain into agricultural, industrial or commercial, residential, resettlement, mineral, timber or forest, and grazing lands, and other classes.

This PD also establishes the multiple uses of forestlands by providing that the numerous beneficial uses of the timber, land, soil, water, wildlife, grass and recreation or aesthetic value of forest lands, and grazing shall be evaluated and weighed before allowing their utilization, exploitation, occupation or possession.

According to this PD, “only the utilization, exploitation, occupation or possession of any forest lands and grazing lands, or any activity therein, involving one or more of its resources which will produce the optimum benefits for the

development and progress of the country and public welfare, without impairment or with the least injury to its resources, shall be allowed.

“The Code is open to the development or use of all forest reservations as long as they are consistent with the principal objectives of the reservation. Critical watersheds, national parks, and established experimental forests, however, shall not be subject to commercial logging or grazing operations, and game refuges; bird sanctuaries, marine and seashore parks shall not be subject to hunting or fishing and/or activities of commercial nature.

“No person may utilize, exploit, occupy, possess or conduct any activity within any forest and grazing land, or establish, install, add and operate any wood or forest products processing plant, unless he has been authorized to do under a license agreement, license, lease or permit. Upon the recommendation of the appropriate government agency, the President may, pending the conduct of appropriate hearing, order the summary suspension of any such contract, concession, license, permit, lease or privilege granted for violations of any of the conditions.”

**5.DENR ADMINISTRATIVE ORDER NO. 99-01.** *Adoption of the Watershed and Ecosystems Planning Framework.*

The DENR officially adopts the Watershed and Ecosystems Planning and Management Framework. Thus, all DENR offices are to review and realign all programs and projects, including their budgets, in accordance with the priority watershed areas of the regions.

**6. DENR ADMINISTRATIVE ORDER 97-02**

This requires the creation of a set of criteria for defining a watershed, prior to the formulation of a watershed management plan.

**7. DENR ADMINISTRATIVE ORDER NO. 95-15.** *Revised General Guidelines in the Implementation of the Sub-Classification of Forestlands and other Inalienable Lands of the Public Domain.*

The Order defines the various forestland classification categories and criteria that will be used for classification. This AO also describes the procedures for the survey, zoning and mapping, processing and approval of the sub-classification.

**8.DENR ADMINISTRATIVE ORDERS NO. 92-23.** *Institutionalization of the Master Plan for Forestry Development within DENR and Defining Functions of Offices for the Purpose.*

This document provides implementation support within the DENR organization for the Philippine Master Plan for Forest Development. This AO also created various support groups and defines their composition and functions.

**9.EXECUTIVE ORDER NO. 263.** *Adopting Community-Based Management as the National Strategy to Ensure the Sustainable Development of the Country's Forestland Resources and Providing Mechanisms for Its Implementation (1995).*

This EO grants organized communities (including indigenous peoples) access to the forestland resources under long-term tenurial agreements, provided

they employ environment-friendly, ecologically sustainable, and labor-intensive harvesting methods.

Superseded by Executive Order 263: DENR Administrative Order No. 93-22 Revised Guidelines for Community Forestry Program

Revised under Executive Order 263: DENR Administrative Orders No. 91-04 Revised Regulations Governing the Integrated Social Forestry Program

**10.DENR ADMINISTRATIVE ORDER NO. 96-29.** *Rules and Regulations for the Implementation of Executive Order 263, otherwise known as the Community-Based Forest Management (CBFM) Strategy.*

The Order establishes the CBFM Program to implement EO 263. Under this program, local organized communities shall be issued tenure instruments and will be assisted by DENR, LGU and other organizations in the preparation of a Community Resource Management Framework. The framework shall serve as a guide in the access, development, use, and protection of resources in areas to be managed by the communities. The Order describes in detail the activities under each stage of the community-based forest management program.

LGUs are to be actively involved in CBFM. Specifically, they should be involved in:

- (a) conducting an Information Education Communication (IEC) campaign with DENR;
- (b) identifying, selecting, and validating CBFM areas;
- (c) endorsing PO applications for CBFMA; and

- (d) assisting in community appraisal, organization, and resource management planning. LGUs may also help finance CBFM development, conservation, and harvesting activities.

**11. DENR ADMINISTRATIVE ORDER NO. 2000-44.** *Amending Certain Provisions of DAO 96-29 and Providing Specific Guidelines for the Establishment and Management of Community-Based Projects Within Protected Areas.*

This Order allows community-based projects inside multiple-use and buffer zones of protected areas, except any form of logging, or timber cutting that involves the natural forest. Qualified tenured migrant communities may participate in the Community-Based Projects and may be issued CBFMAs (Community-based Forest Management Agreements) within protected areas. These agreements (CBFMAs) will be endorsed by the Protected Area Management Board.

**11.DENR ADMINISTRATIVE ORDER NO. 2000-29 GUIDELINES.** *Regulating the Harvesting and Utilization of Forest Products within Community-Based Forest Management Areas.*

These guidelines require holders of tenurial instruments under the CBFM program of DENR to secure a Resource Use Permit before they can use naturally grown and/or planted forest resources. The tenure holders should have an affirmed Community Resources Management Framework and Annual Work Plan. The extraction of forest products will be limited only to identified production zones. The remaining forest areas should not be less than 80 cubic meters per hectare after harvesting.

**12.DENR ADMINISTRATIVE NO. 99-35.** *Revised Guidelines in the Implementation of the Resource Use Permit in Community-Based Forest Management Programs.*

The Order suspends the processing and issuance of resource use permits for CBFM holders and other people-oriented forestry projects. This Administrative Order provides more guidelines for the formulation and approval of resource use permits.

**13.DENR ADMINISTRATIVE ORDER NO. 99-29.** *Amendments to DAO No. 96-29 which Prescribes the Rules and Regulations for the Implementation of Executive Order No. 263, otherwise known as the Community-Based Forest Management Strategy.*

DAO No. 99-29 makes changes to DAO 96-29, which prescribes the implementing rules and regulations of EO 263. In particular, DAO No. 99-29 repeals the requirement in DAO No. 96-29 for LGUs to endorse/affirm the CRMFs, AWP and RUPs of CBFM POs. Instead, LGUs should be provided copies of approved CBFMs, CRMFs, AWP, REDs, PENROs, and CENROs are to continue/enhance their close coordination with concerned LGUs

**14.DENR ADMINISTRATIVE ORDER NO. 99-28.** *Amendment to Certain Provisions of DENR Administrative Order No. 12 Series of 1993 entitled "Revised Guidelines Regulating the Implementation and Management of DENR-CARP Activities."*

This order redefines DENR's involvement in the Comprehensive Agrarian Reform Program (CARP) to include the allocation of non-alienable lands suitable

to agroforestry through the implementation of CBFM. This order also mandates DENR to train LGUs and Department of Agrarian Reform (DAR) staff in order to enhance their technical expertise to support the implementation of the CBFM Program. The order also describes in detail the DENR-CARP organizational structures and their functions.

**15.DENR ADMINISTRATIVE ORDER NO. 99-11.** *Amending DAO 98 Series of 1988 to Include CBFMP Under the Coverage of Program D of the Comprehensive Agrarian Reform Program (CARP) and the National Anti Poverty Program.*

Program D of CARP should now include public A and D lands, as well as forestlands. To implement agrarian reform in public lands, the program should also include both land transfer and non-transfer CBFM schemes. The allocation of lands through the CBFM Strategy should conform to the provisions of DAO 96-29.

**16.DENR ADMINISTRATIVE ORDERS NO. 98-41.** *Guidelines on the Establishment and Management of Community-Based Forest Management (CBFM) Projects Within Watershed Reservations.*

These guidelines concern the implementation of the CBFM strategy inside watershed reservations, which must be in accordance with the provisions of the National Integrated Protected Areas System (NIPAS) law and be consistent with the principles of multiple use, sustainable management, and biological diversity conservation.

The tenorial instruments and the procedure for implementing CBFM Projects inside watershed reservations will follow DAO 96-29 and related policies, provided that the Protected Area Superintendent and the Protected Area Management Board (PAMB) are involved in all phases of CBFM implementation. LGUs are tasked to provide assistance and help monitor the implementation of the affirmed CRMF and AWP.

**18. DENR MEMORANDUM CIRCULAR NO. 98 – 08. *Guidelines on Contracting Inside CBFM Areas.***

The order sets the rules and regulations to hasten and systematize two types of contracting inside CBFM areas: (a) service contract for the extraction, transport, processing, and marketing of forest products, and (b) development contract for the development of portions of CBFM areas into plantations, agro-forestry, livestock production, eco-tourism and other developmental activities as contained in the affirmed Community CRMF of the POs.

The guidelines provide that the PO should furnish the LGU with a copy of any service or development contract and that the CENRO and LGUs shall jointly and periodically monitor the implementation of the contracts.

**19. DENR MEMORANDUM CIRCULAR NO. 97-12. *Guidelines for the Formulation of the Community Resource Management Framework and Annual Work Plan for Community-Based Forest Management Areas.***

This circular defines the content and procedures for the preparation and affirmation of the Community Resource Management Framework (the

community's strategic plan for managing and benefiting from the forest resources on a sustainable basis) and Annual Work Plan.

**20. DENR MEMORANDUM CIRCULAR NO 97-11.** *Operationalization of the CBFM Program at the Regional, PENR, and CENR Offices.*

The regional offices are tasked to organize a CBFM Office to coordinate the implementation of the CBFM Program in the region. This office will be under the regional technical director for Forest Management Services. CBFM Teams at the CENRO are also created to undertake, monitor, and support field implementation.

**21. DENR ADMINISTRATIVE ORDERS NO. 96-30**

*Integration of All Community-Based Forest Management and People-Oriented Forestry (POF) Programs and Projects into the DENR Regular Structures.*

This Order seeks to integrate all DENR programs and CBFM and POF projects. It also aims to provide a smooth transition in the turnover of all CBFM and POF programs and projects to the Forest Management Bureau (FMB). The Order also creates the CBFM Office (CBFMO) in FMB and a CBFM Advisory Committee to provide technical and administrative guidance to the CBFMO during the transition period.

**22. DILG MEMORANDUM CIRCULAR NO. 96-143.** *Enjoining Support for the Community Forestry Program (CFP).*

Directs local authorities, particularly cities and municipalities, to undertake community-based forestry efforts and other initiatives in protecting the natural ecosystem. The Community Forestry Program (CFP) preceded CBFM.

**23. DENR ADMINISTRATIVE ORDER NO. 99-53.** *Regulations Governing the Industrial Forest Management Program (IFMP).*

This order repeals DAO 91-42, DAO 93-60, and DAO 97-04. The order defines the areas available for IFMP, which comprise the following:

- (a) open and denuded lands, brushlands;
- (b) degraded residual natural forests;
- (c) areas covered by cancelled/expired Forest Land Grazing Agreement or pasture permits or leases;
- (d) government reforestation projects or portions thereof found to be more suitable or can be better developed as IFP;
- (e) production residual natural forest that may be best included in any of the aforementioned areas and be a part of the managed forest under the Integrated Forest Management Agreement (IFMA);
- (f) areas under cancelled and expired Tenurial Land Agreements (TLAs).

The order also establishes procedures in the processing of applications and approval of IFMAs, defines the terms and conditions of the IFMA, and the incentives and profit-sharing arrangements under the program.

**24. DENR ADMINISTRATIVE ORDER NO. 96-24.** *Rules and Regulations Governing the Socialized Industrial Forest Management Program (SIFMP).*

This provides for the issuance of a Socialized Industrial Forest Management Agreement (SIFMA) to qualified tree planters. SIFMAs may cover all grasslands, brushlands, and open and denuded forest lands under the jurisdiction of the DENR -- including those within government reforestation projects -- and not otherwise to be classified under the NIPAS or subject of CADC, CALC, vested rights, licenses, permits or management agreements.

The order outlines the procedures to be followed from the selection of SIFMA sites to the award of the SIFMA itself. LGUs are involved in the validation and mapping of potential SIFMA sites, in the conduct of information campaigns, and in site monitoring and evaluation.

**25. REPUBLIC ACT NO. 8371.** *An Act to Recognize, Protect and Promote the Rights of Indigenous People, Establishing Implementing Mechanisms, Appropriating Funds Therefore, and For Other Purposes (1997).*

This law recognizes the applicability of customary laws governing property rights or relations in determining the ownership and extent of ancestral domain. The government shall identify lands that Indigenous Cultural Communities (ICCs) or Indigenous Peoples (IPs) traditionally occupy and guarantee effective protection of their rights of ownership and possession through the issuance of a Certificate of Ancestral Domain Title (CADT).

This RA further provides the procedures for the delineation process and guidelines of options regarding the management of critical watersheds, mangroves, wildlife sanctuaries, wilderness, and protected areas within ancestral domains.

This law creates the National Commission on Indigenous Peoples (NCIP), which is mandated to formulate and implement policies, plans, and programs to promote and protect the rights and well being of ICCs/IPs, and recognize their ancestral domains.

Superseded by the IPRA of 1997: DENR Administrative Orders No. 96-34 and 93-02

**26. REPUBLIC ACT NO. 7586.** *National Integrated Protected Area System (NIPAS) Act (1992).*

The law calls for the establishment of a National Integrated Protected Areas System (NIPAS) and adopts the following categories of protected areas:

- (a) strict nature reserve;
- (b) natural park;
- (c) natural monument;
- (d) wildlife sanctuary;
- (e) protected landscapes and seascapes;
- (f) resource reserve; and
- (g) natural biotic areas.

It places the NIPAS under the control and administration of the DENR. For each of the established protected area, a Protected Area Management Board (PAMB) should be created. The law also creates a trust fund to be known as Integrated Protected Areas Fund for funding NIPAS projects.

**27. DENR ADMINISTRATIVE ORDERS NO. 92-25.** *National Integrated Protected Areas System (NIPAS) Implementing Rules and Regulations.*

This Order describes the various steps to be taken by DENR in the (a) establishment of the initial component of the NIPAS, (b) establishment of additional protected areas, and (c) establishment of some protected areas. It also sets the guidelines for the preparation, approval, and adoption of protected area management plans, as well as a description of the various management zones and a detailed outline of the plan. It includes a salient provision on the creation and composition of the PAMB, which has representatives from the provincial, municipal and barangay LGUs.

**28. DENR ADMINISTRATIVE ORDER NO. 99-21.** *Superseding DAO No.97-05 and Prescribing the Revised Guidelines in the Implementation of the Pertinent Provisions of R.A. 1273, P.D. 705 and P.D. 1067.*

This order provides that the following be demarcated and preserved as permanent timberland:

- (a) strip of 40 meters wide starting from the bank on each side of any river or stream;
- (b) 20-meter strips of land along the edge of the normal high waterline of rivers and streams with channels of at least five meters wide; and
- (c) strips of mangrove or swamplands at least 20 meters wide, along shorelines facing oceans, lakes, and other bodies of water, and strips of land at least 20 meters facing lakes. The necessary surveys will be undertaken to reflect these areas in maps and titles.

**29. DENR MEMORANDUM CIRCULAR NO. 93-16.** *Guidelines on the Establishment and Management of Buffer Zones for Protected Areas.*

The purpose of this circular is to prevent destruction of the protected area by establishing buffer zones outside its boundaries. The circular establishes the ecological, social, and economic criteria for this.

**30. DENR ADMINISTRATIVE ORDERS NO. 92-13.** *Regulations Governing the Establishment of Buffer Zones Within Forestlands.*

This order was issued to ensure the sustainability of the remaining forest resources by establishing buffer zones between the boundary of production forests and areas used for agricultural and other purposes.

**31. DENR ADMINISTRATIVE ORDERS NO. 91-24.** *Shift in Logging from the Old Growth (Virgin) Forests to the Second Growth (Residual) Forests.*

Effective 1 January 1992, logging of the virgin forest will be prohibited. Logging operations will shift to residual forests with prohibitions in certain areas. Timber License Agreements (TLA) and Timber Production Sharing Agreement (TPSA) holders are ordered to conduct a timber inventory of their residual forests if they are to continue their logging operations.

**32. REPUBLIC ACT NO. 7942.** *The Philippine Mining Act (1995) An Act Instituting a New System of Mineral Resources Exploration, Development, Utilization, and Conservation (1995).*

The Act covers the exploration, development, use and processing of all mineral resources. It defines the areas that are open to mining operations and

closed to mining applications. For instance, all mineral resources in public or private lands, including timber or forest lands as defined in existing laws, are open to mineral agreements or financial or technical assistance agreement applications.

Closed to mining applications are the following areas:

- (a) military and other government reservations, except upon prior written clearance by the government agency concerned;
- (b) areas near or under public or private buildings, cemeteries, archeological and historic sites, bridges, highways, waterways, railroads, reservoirs, dams or other infrastructure projects, public or private works including plantations or valuable crops, except upon written consent of the government agency or private entity concerned;
- (c) areas covered by valid and existing mining rights;
- (d) areas expressly prohibited by law to be mined; (e) areas covered by small-scale miners as defined by law, unless with prior consent of the small-scale miners; and (f) old-growth- or virgin forest-proclaimed watershed forest reserves, wilderness areas, mangrove forests, mossy forests, national parks, provincial/municipal forests, parks, greenbelts, game refuge and bird sanctuaries, as defined by the NIPAS law. No ancestral land shall be opened for mining operations without the prior consent of the indigenous cultural community concerned.

The Act describes the different arrangements, agreements and permits that the DENR can issue for the exploration and use of mineral resources, and lists the incentives available to investors in mineral development.

**33. DENR ADMINISTRATIVE ORDER 96-40.** *Revised Implementing Rules and Regulations of Republic Act No. 7942 Otherwise Known as the “Philippine Mining Act of 1995.”*

This order transforms the Mines and Geo-Sciences Bureau (MGB) from a staff into a line bureau. It also defines the functions of local government units as follows: (a) ensure that relevant laws on public notice, public consultation and public participation are complied with; (b) in coordination with DENR, approve applications for small-scale mining, sand and gravel operations, quarrying, guano- and gemstone-gathering, and to approve gratuitous permits for industrial sand and gravel operations not exceeding five hectares; (c) receive their share (as provided for by law) in the wealth generated from the use of mineral resources and thus enhance economic progress and national development.

Furthermore, LGUs are supposed to: (d) facilitate the means by which a community can make an informed decision on the social acceptability of a mining project, a requirement for the issuance of an Environmental Compliance Certificate; (e) participate in the monitoring of any mining activity as a member of the Multipartite Monitoring Team; (f ) participate as a member of the Mine Rehabilitation Fund Committee; (g) receive social infrastructure and community development projects for the use of the host and neighboring communities; (h) act as mediator between the Indigenous Cultural Community(ies) and the Contractor(s).

Among others, the order sets out in detail the procedures and rules for the establishment and dismantling of mineral reservation, as well as rules for mining

operations within mineral and government reservations. It also describes the eligibility criteria and the terms and conditions of exploration permits, mineral agreements, financial or technical assistance agreements, and quarry operations. The Order establishes the conditions for applications for quarry permits, sand and gravel permits, and small-scale mining permits from the Provincial Governor/City Mayor through the Provincial/City Mining Regulatory Board, which are to be created for each province/city.

**34. DENR ADMINISTRATIVE ORDER NO. 99-57.** *Amendments to DAO 96-40 or the “Revised Implementing Rules and Regulations of RA No. 7942, Otherwise Known as The ‘Philippine Mining Act of 1995.’”*

Major amendments to the Mining Act are made, covering the following:

- (a) establishment of the term and maximum areas allowed under an exploration permit;
- (b) transfer or assignment of Exploration Permit applications;
- (c) terms and conditions of the Exploration Permit and Mineral Agreement (MA);
- (d) possible conversion of an Exploration Permit to an MA or a Financial or Technical Assistance Agreement (FTAA) and vice versa;
- (e) issuance of Special Mines Permit;
- (f) mandatory requirements for filing of an FTAA;
- (g) general provisions for quarrying and extraction of sand and gravel, guano, and gemstone resources in private and/or public lands.

**35. DENR ADMINISTRATIVE ORDER NO. 2000-07.** *Provisional Guidelines for Environmental Impact Assessment (EIA) of Forestry Projects.*

Pending the finalization and issuance of scoping guidelines for forestry projects, all applicants for Integral Annual Operational Plans are required to submit an Initial Environmental Examination (IEE) and other certifications.

**36. DENR ADMINISTRATIVE ORDER NO. 99-15.** *Designating the Forest Management Bureau as the Lead Agency in the Implementation of the Environmental Impact Statement System for Forestry Projects.*

The Forest Management Bureau (FMB) assumes all functions relative to the EIS System for Forestry Projects. The EMB Director should turn over to the Forest Management Bureau all Environmental Impact Statements and Environmental Compliance Certificates as well as other documents pertaining to Forestry Projects. The FMB Director is authorized to create an Environmental Impact Assessment Unit and designate the necessary personnel.

**37. DENR MEMORANDUM ORDER NO. 99-29.** *Guidelines in the Implementation of Usufruct Rights in Tree Farming Within Forestlands Where Occupation is Not Allowed.*

This order grants DENR employees -- as individuals or as an association or organization -- usufruct rights over forestlands where occupation is not allowed (e.g., critical watersheds, buffer zones/multiple-use zone of protected areas, etc.) for the establishment, protection, and maintenance of tree farms. The appropriate tenurial agreement is the Contract of Usufruct, which includes the profit-sharing

scheme with the government. In no way does this contract give the participant acquisitive or ownership rights over the land.

**38. DENR ADMINISTRATIVE ORDER NO. 99-13. *Declaring Certain Portions of the Public Forestlands in Region 13 as the CARAGA Forest Plantation Corridor (CFPC).***

This sets aside some 684,503 hectares of open/denuded lands, brushlands and degraded second growth forests in the provinces of Agusan del Sur, Agusan del Norte, Surigao del Norte, and Surigao del Sur as part of the CFPC.

This order indicates the technical description of the parcels. The CFPC is reserved permanent forestland for the production, mainly of timber and non-wood forest products that will support forest-based processing facilities and/or supply wood and other forest product requirements to both the domestic and foreign markets. Areas programmed for forest plantation development under various tenurial instruments within the CFPC may apply with the DENR to avail of incentives for investors/developers in the Corridor.

**APPENDIX B****PERSONAL NARRATIVE OF A MINDANAO FARMER-BUSINESSMAN,  
WITH NEARLY 5 DECADES OF EXPERIENCE LIVING AND WORKING  
IN MIDANAO, ON WATER CRISIS AND CLIMATE CHANGE**

*By, Mr. John Perrine*

*(former Chairman and CEO of Unifrutti Group Philippines)*

The world has become ever more conscious of global climate change, but even before the impact of bigger picture issues related to climate change – the Philippines was undergoing its own man-induced local climate change which has already severely affected agricultural productivity.

Briefly, some bullet points to illustrate, using Davao as the example, but one which is typical of what is happening all around the Philippines – or already happened earlier than Davao:

1. The banana industry started in Davao in 1968 due to its climate blessed by no typhoons, and the ideal weather for lowland banana production – sunny mornings, followed by very regular afternoon rains between 2:00-5:00 p.m., clearing up in the evening to return to sunny skies the next morning.
2. This weather pattern was typical pretty much throughout Mindanao for 9-10 months of the year. The 2 -2 ½ months of dry season also came regularly between February and April each year – but there were still three or more showers each week throughout the dry season, assuring the moisture that crops needed.

3. This result was banana production that did not need irrigation – and corn production in many parts of Mindanao that was good for three crops per year. Into the 1980's, you could see trucks of newly harvested corn almost every day of the year.
4. By the early 1990's, to maintain banana production – commercial farms began to install irrigation systems – because the rainfall had become sporadic, with more frequent periods of low rainfall that was insufficient to maintain the 49 mm per week required by bananas to maintain peak production. The early irrigation systems were big overhead guns, pumping from rivers that were still flowing with abundant water, even in the driest months.
5. Fast forward another 15+ years, and today, no commercial farm can sustain peak production without irrigation. Except, the problem is that even if one has the capital to invest in irrigation facilities, water sourcing has become critical during the dry season months.
6. We have some farms bounding the Davao gulf, where 25% of our wells have been condemned because of salt water intrusion – due to insufficient recharging of the subterranean aquifers as there aren't enough trees up in the mountains to hold the rains long enough for the water to percolate down.
7. During the dry season, farms that used to be able to sustain full irrigation with water pumped from rivers have been short by 30-75% of water

because the rivers have run so low...due to loss of trees in the mountains to hold rainwater for slow release over the dry months.

8. We have farms that had main canals for drainage of excess rain water that were 1.5 meters above the water level of the rivers into which they drained into when we built these farms in 1992...and now 18 years later, the river bottom has risen 1.5 meters and is level to the bottom of the canals because of heavy siltation due to loss of trees that controlled the erosion on steep mountain slopes.
9. Corn farmers who used to plant native corn and get 3.5 tons per hectare x 3 crops per year for a total of 10.5 tons per hectare per year, with cheap seed and low inputs of fertilizers and chemicals...now plant in April/May when the rains come back, sometimes suffering from a sudden dry period after the seeds have sprouted and then die, and must replant but can't afford to fertilize again. Then their second crop in September often runs short on rain during tasseling stage so the cobs have many empty kernels and the yield is low. And there is no 3<sup>rd</sup> crop. So the average crops per year is down to 1.5 to 2 harvests, but the farmer has ended up saddled with debt due to the expensive seed and high fertilizer and chemical requirements of the new high yielding hybrids. Yes, high yielding – IF the farmer can apply ALL the higher level of inputs.... And the greatest risk, is that he cannot apply the water for the crop when it is needed, because the rain is short, and the irrigation water is also short from the rivers. The green revolution of hybrid seed and intensive agriculture only works when you

have the most basic input when the crop needs it: water. And most agricultural areas in the Philippines do not have this basic input when it is needed. Result: crop failures and farmers in eternal debt. We have lost the productivity of our land by 50%.

10. NIA records of rivers in Bukidnon, for example, show that over the last 30 years, the average water flow during the dry season months is 75% LOWER than it was just 30 years ago. All over the country, you can see big irrigation systems that don't have enough water to support a second crop of palay in their service areas.
11. These effects were in play before the bigger picture effects of global climate change aggravated it further. In 1970, the Philippines still had 30% primary forest cover. In the year 2000, this was down to 3%. Today,, this is probably now close to 1.5%. Our mountain forests are the generator of rainfall for rainfed agriculture on the plains. The forests' humus holds that rain water like a giant sponge – releasing it slowly through the summer months – and allowing that water time to percolate down into the subterranean aquifers.

We can no longer address drought management by investing in irrigation systems. But I have seen myself that even small planting of trees up in the mountains can actually produce a localized microclimate – producing rain showers in the dry season and a watershed that produces running creeks in once dry gullies. It will take 10 years to bring the tree cover up to the biomass density that can produce the cooling effect that causes condensation as rain...and root systems that can hold

the water...but 10 years is a short time if within such a period a reversal can actually occur, and rainfall can be restored at each location, one step at a time....

What is encouraging about this, is that such a program can be addressed by each company, or each farming community, by planting trees in their own backyards. It does not take a massive, government program of planting thousands of hectares of trees. Microclimates can be created in everyone's own backyard....

If we don't do this now, we will lose what little water resources that we have left, and the Philippines will continue to become a larger and larger food importer, a nation that cannot feed itself.

**APPENDIX C**  
**CURRICULUM VITAE**  
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Urooj is a global citizen having lived, studied and worked in a number of countries around the world. He is a seasoned professional commanding 35 years of experience in inclusive and sustainable development management. He is currently a Visiting Professor at Mindanao State University – Main Campus at Marawi City where he is engaged in teaching and research in the doctoral and masters programs on public administration and policy, and sustainable development and peace studies in the College of Public Affairs and the College of Social Sciences and Humanities, respectively. Urooj also serves as the Senior Adviser on Development Management at the Bangsamoro Development Agency and the Bangsamoro Autonomous Government in Mindanao, The Philippines.

Urooj is the former Chairman and CEO of Hineleban Foundation Inc. (HFI), a social development organization with a focus on ecosystem conservation and livelihood development located in Mindanao. While at HFI, Urooj was responsible for providing overall supervision and strategic direction to the Foundation's programs and in realizing the Foundation's vision and mission. Prior to joining HFI, Urooj

was with the Asian Development Bank (ADB) where his career spanned over two and half decades.

During his last 10 years at ADB, Urooj served in the management stream, first as Country Director for Cambodia, then as Director for Mekong Energy and Infrastructure, and finally as Director for Agriculture, Environment and Natural Resources for entire Southeast Asian region. Concurrent to his positions as Director, he was Co-Chair of Environment Community of Practice, Chair of Greater Mekong Subregion Working Groups on Energy, Infrastructure, Agriculture and Environment, and Member of Advisory Panel for the Study on the Economics of Climate Change in Southeast Asia.

Urooj has held a number of senior advisory positions which, among others, include Regional Project Management Adviser for ADB/OPEC-funded community-driven development project, Senior Technical Adviser for the World Bank on a study on Agribusiness Development, and Chief Economic Adviser on a Australian-funded project for conceptualizing, preparing and implementing the Framework for Transformative Corporate-Community Business Sustainability and Peace in Conflict-Affected Mindanao. Recently, he was Distinguished Visiting Professor at De La Salle University – Manila where he taught resource and agricultural economics, conducted research and training on inclusive agribusiness models, and developed the syllabus for an elective course on Paradigms in Conflict, Peace and Sustainable Development.

He has also been involved in a number of governance and public policy training programs and strategy development for capacitation of officers and civil servants of the Bangsamoro Autonomous Government, and ex-commanders and combatants of the Moro Islamic Liberation front for helping them to reintegrate into society. Recently, he has been involved as Corporate Strategy Adviser in preparation of modules and trainings on governance, strategy and policy development for senior staff of the Islamic Development Bank under the auspices of the United Nations.

Urooj holds an undergraduate degree in Environment and Natural Resource Management from the University of Wisconsin - Madison, and graduate degree in Mineral and Resource Economics from the University of Arizona - Tucson. He successfully completed a Management Development Program from Cornell University. He has also undertaken a number of training courses on peace education, leadership and management development programs conducted by the faculties of Duke, Columbia and Notre Dame universities, and INSEAD.

Urooj has authored numerous reports and articles and spoken on topical themes relating to resource economics and development and spoken at various conferences and seminars at various places around the world. He is a recipient of several high level awards from a number of governments and private agencies in the Asia-Pacific region.

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