# Exploring the Spatial Patterns and Determinants of Poverty: The Case of Albay and Camarines Sur Provinces in Bicol Region, Philippines

A Dissertation Submitted to
the Graduate School of Life and Environmental Sciences,
the University of Tsukuba
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
(Doctoral Program on Geoenvironmental Science)

**Brandon Manalo VISTA**

# Abstract

Poverty has a spatial dimension. Geography, particularly the physical environment, plays a significant role in the poverty condition of communities and of the people living in disadvantaged regions. However, this spatial dimension of poverty has not been given much attention in many poverty studies, especially in the Philippines. In an attempt to underscore its importance, this study explores the spatial patterns and the possible underlying determinants affecting poverty condition in two adjacent provinces of Albay and Camarines Sur, located in Bicol Region, one of the poorest in the country. Agro-climatic condition which consists of slope, elevation, soil, rainfall and access to river, as well as access to road infrastructure and proximity to major markets were all derived using GIS. Together with the influence of government programs and policies i.e., fiscal decentralization and land distribution, and population growth, all of these variables were combined using multiple regression analysis to investigate their effect on poverty. Results of the study show that the spatial patterns of poverty in terms of incidence exhibit spatially heterogeneous characteristics. The spatial variation in the incidence of poverty is mainly caused by disparities on access to road infrastructure which is further exacerbated by loopholes and geographical bias in fiscal funding priorities and deficiency in agrarian reform implementation. Moreover, proximity to major cities where there is a high concentration of development and economic activities and differences in agro-climatic features, particularly, elevation, slope, and rainfall also proved to be significant determinants to poverty and suggest the presence of geographically disadvantageous areas within the study site. Thus, geography and facets of public policy have a strong impact on the condition of poverty of communities.

**Keywords:** Geography of poverty, Spatial patterns, Poverty determinants, Poverty mapping, Poverty analysis, GIS, Bicol, Philippines

# Table of Contents

# List of Figures

# List of Tables

# List of Maps

# List of Appendices

# List of Acronyms

| | |
|---|---|
| BSWM | Bureau of Soils and Water Management |
| CARP | Comprehensive Agrarian Reform Program |
| CPH | Census of Population and Housing |
| CY | Calendar Year |
| DBM | Department of Budget and Management |
| DAR | Department of Agrarian Reform (now Department of Land Reform) |
| DA | Department of Agriculture |
| FAO | Food and Agriculture Organization of the United Nations |
| FIES | Family Income and Expenditure Survey |
| GIS | Geographic Information System |
| GAEZ | Global Agro-ecological Mapping Zone |
| IRA | Internal Revenue Allotment |
| LGU | Local Government Unit |
| MDG | Millennium Development Goals |
| NAMRIA | National Mapping and Resource Information Authority |
| NEDA | National Economic and Development Authority |
| NSCB | National Statistical Coordination Board |
| NSO | National Statistics Office |
| PAG-ASA | Philippine Atmospheric, Geophysical and Astronomical Services Administration |
| RDC | Regional Development Council |
| SAE | Small Area Estimation |
| SRTM | Shuttle Radar Topography Mission |
| UNDP-HDR | United Nations Development Program – Human Development Report |
| WB | World Bank |
| WRI | World Resources Institute |

# Chapter 1

# Introduction

## 1.1 Background of the Research Problem

Poverty is one of the most pressing problems of humanity for the last century. At the turn of the millennium, no less than the World Bank estimated that about 1.2 billion people worldwide or one out of every five people on earth are struggling to survive on less than US $1 per day, while twice as many, 2.8 billion people on less than US$ 2 (UNDP-HDR: 2003). Finding ways to reduce poverty indeed is a daunting challenge for local, national and international decision makers. One of the important challenges is the spatial heterogeneous characteristics of poverty in most countries (Hennigner and Snel, 2002).

Poor people tend to be clustered in specific places (Hennigner and Snel, 2002). Geography plays a significant role because it has a strong impact on the living standards of people living in the community especially in developing countries (Bigman and Fofack, 2000). Significant geographic variation in the incidence rates of poverty may be due to a variety of reasons including differences in agro-climatic conditions and geographic characteristics, particularly access to main urban centers and markets, presence of natural resources such as water for irrigation, and other non-physical conditions and facets of public policy (Bigman and Fofack, 2000; Ravallion and Wodon, 1997). On this regard, according to a distinguished human geographer in the United States, "poverty is an inherently a **spatial** problem… (Glasmeir, 2002) (emphasis supplied). Geography, particularly the physical environment, could not be disregarded as a factor affecting poverty condition of places and of the people living in disadvantaged regions. Therefore, poverty analysis should adopt a spatial approach because poverty has a spatial dimension.

However, much of the focus of studies on geography of poverty over the past few decades relates to "people poverty" - the characteristics of individuals or households and the geography of income or income proxy measures (Powell *et al.*, 2001). "Most of the key poverty text focused largely on the social components of poverty through analyses of headline national statistics, with relatively little attention given to its spatial characteristics" (Milbourne, 2004). Despite the spatial emphasis on poverty initiated by Charles Booth as early as the $19^{th}$ century (cited in Vaughan *et al.*, 2005), there has been a lack of prominence on the spatial aspect of poverty as dealt by numerous studies. Besides, although there is a growing literature which addresses neighborhood effects, proximity and spatial patterns and processes in the social sciences, less work is available on these topics in studies of poverty (Hyman *et al.*, 2005).

In recent years, however, there is an increasing recognition of the role of geography in understanding and analyzing poverty. The development of geographic information systems (GIS) together with advances in remote sensing has taken the leap to incorporate spatial data and satellite imageries suitable for poverty analysis (Deichman, 1999; Bigman and Fofack., 2000; Hyman *et al.*, 2005). GIS was also found to be useful in highlighting geographic variations of poverty and simultaneously displaying different dimensions and understanding its determinants at disaggregated level. This would in turn allow visual comparisons of its multidimensional characteristics and provide an avenue for analyzing spatial patterns and its determinants. Such a technique is known as poverty mapping – the spatial representation and analysis of indicators of human well-being (Davis, 2003). In other words, poverty mapping is becoming a new trend today, which is made possible with GIS and remote sensing.

## 1.2 Statement of the Research Problem

Despite recent advancement in poverty mapping brought about by GIS and remote sensing, little has been done to study the spatial aspects of poverty in developing countries particularly in the Philippines. More often than not, poverty analysis in the Philippines resides within the economic and policy realm which do not consider so much on its spatial dimension. Although there were a few poverty mapping initiatives over the past few years (Domingo, 2003), GIS was mostly used for the production of various poverty maps by plotting various socio-economic indicators and not for spatial analysis. If indeed, geography affects the state of poverty in every location, geographical factors should therefore be incorporated as variables in understanding and analyzing poverty condition in the country.

Given the current agenda espoused in the Millennium Development Goals (MDG) of the United Nations aiming to eradicate extreme poverty and hunger by the year 2010 and the capability of GIS to incorporate spatial variables in poverty analysis, it is extremely important, timely and relevant to explore the geographic aspects of poverty condition in the Philippines in order to improve the targeting of government's poverty alleviation programs.

## 1.3 Research Objectives

In an attempt to underscore the importance of geography in analyzing poverty, this study aims to explore the spatial patterns and the possible underlying determinants affecting poverty condition in the poorest regions in the Philippines using GIS. Specifically, this study aims to:

1. To determine the key factors that may have an influence on the incidence of poverty; and
2. To elucidate the possible reasons concerning the spatial variations in the incidence of poverty.

## 1.4 Research Methodology

To achieve the objectives of this research, first, related literature and previous studies were reviewed in order to draw insights and lessons that would help in the formulation of a conceptual framework which would serve as the guide to explore the spatial patterns and determinants of poverty. Thereafter, two provinces in one of the poorest region in the Philippines were selected as a case study area since it would be impossible to cover the whole country given the data constraints and time limitation.

Guided by the conceptual framework, both spatial and non-spatial data from the field were collected in various formats - satellite images, maps, shapefiles including secondary data sources disaggregated at the municipal level. A GIS was set-up for integrating all of the collected datasets and perform appropriate analysis. For spatial data, pre-geoprocessing techniques were done while non-spatial datasets were encoded to constitute a single geospatial database. Subsequently, all of the collected data were mapped using GIS to visualize the spatial patterns of poverty in the study area. On the other hand, to determine the geographical factors affecting the incidence of poverty, a series of spatial analysis for all the spatial datasets were carried out in order to derive municipal-based auxiliary datasets that could be associated with poverty. A multivariate regression analysis was executed on this regard. The key feature of this research is the production of various poverty maps generated using GIS. The visual language of maps could aid in identifying the geographic patterns of poverty and explore its relationship with the environment.

## 1.5 Significance of the Study

The research is very timely and significant in the light of very scarce resources of the Philippine government concerning its program measures and strategy to combat poverty, especially in the rural countryside. Results of the study could provide valuable information to policy planners and key decision makers both at the national and local government on the spatial patterns and determinants of poverty in order for them to effectively respond and provide the kind of assistance that poor communities need. The incorporation of geographic factors that may possibly affect the prevailing poverty conditions in the selected site can significantly enrich poverty analysis and can possibly influence the formulation of responsive policies that are necessary to combat its persistence.

This study could also both contribute to the field of Geography and to the emerging and interdisciplinary field of Spatial Information Science since the research by itself provides an example of how GIS could serve as a tool for poverty analysis. The use of GIS in this study also bridges the gap between the physical and social sciences by organizing and analyzing both spatial and non-spatial data that are currently available and interpreting the results to provide a deeper understanding of the existence of poverty in selected study area.

## 1.6 Thesis Structure

The thesis is divided into six (6) chapters.

**Chapter 1** herein outlines the research problem, objectives of this study, the research methodology, research significance and the scope and limitations of the study.

**Chapter 2** reviews related literature on the definitions of poverty, various methodologies on poverty mapping and analysis and recent findings that underscore the role of geography in looking for spatial patterns and causes of poverty in several country case studies in order to draw insights and lessons and, subsequently, formulate a conceptual framework that will serve as the overarching guide in exploring its spatial patterns and determinants.

**Chapter 3** provides a brief description of the selected case study area, its physical condition particularly its general topographical features, geopolitical subdivisions and socio-economic characteristics, all of which could aid in understanding the patterns of poverty in the study site.

**Chapter 4** discusses in full detail the GIS methodologies employed in mapping the spatial pattern of poverty and the various spatial analysis that were executed to derived the different spatial variables that could possibly affect poverty condition in the selected study area.

**Chapter 5** provides a thorough discussion and analysis of the spatial patterns and determinants of poverty in the selected study site based from the results of the regression analysis. Each identified spatial and non-spatial variables and their influence to the incidence of poverty is discussed in this chapter. Additional secondary data in relation to every variable is also presented to enrich the analysis.

Finally, **Chapter 6** summarizes the findings of the study and thereafter draws concluding remarks from the empirical findings and suggests implications for further research.

# Chapter 2

# Review of Related Literature and Conceptual Framework

This chapter reviews existing related literature on poverty, methodologies on poverty mapping and analysis and recent findings that underscore the role of geography in looking for spatial patterns and causes of poverty in several country case studies. At first, concepts and definition of poverty are clarified in order to situate the context in which this research defines poverty. Secondly, the various methods for poverty mapping and analysis with the aid of GIS will be explained in order to get an insight on how this could be applied in this research. Lastly, selected case studies from development countries will be presented in order to provide a conceptual framework on what types of variables could be examined as possible determinants in the selected case study area.

## 2.1 Theories and Definitions of Poverty

Poverty has been viewed and defined in many ways. The most common notion is the monetary dimension which is based on household income and/or expenditure criteria. Low or insufficient income would mean the lack or command over commodities in general that is deemed essential to constitute a reasonable standard of living in society. A person or family is therefore considered poor if his income falls below an established poverty line – an established agreed-upon budget for basic needs for a society in a particular point in time.

Common acceptable measures associated with income/expenditure poverty concept is poverty incidence, poverty depth and poverty severity. *Incidence of poverty (headcount index)* is the share of the population whose income or consumption is below the poverty line/threshold. On the other hand, *depth of poverty (poverty gap*) measures how far off households are from the poverty line. It captures the mean aggregate income or consumption shortfall relative to the poverty line across the whole population. *Severity of Poverty (squared poverty gap)* takes into account not only the distance separating the poor from the poverty line, but also the inequality among the poor (Coudouel *et al.*, 2002).

However, recently, this narrow approach to poverty in terms of falling below certain minimum levels of income or consumption is no longer widely accepted. Progressively, poverty is viewed as "multidimensional extending from low levels of health and lack of education, to other 'non-material' dimensions of well-being, including gender gaps, insecurity, powerlessness and social exclusion." Poverty is associated not only with insufficient income or consumption but also with insufficient outcomes with respect to health, nutrition, literacy, to deficient social relations, to insecurity, and low self-confidence and powerlessness (Coudouel *et al.*, 2002).

Correspondingly, in the Philippines, Republic Act 8425 a.k.a. the Social Reform and Poverty Alleviation Act of 1997 defines the poor as individuals and families whose income fall below the poverty threshold as defined by the government and/or cannot afford in a sustained manner to provide their basic needs of food, health, education, housing and other amenities of life. This definition to a certain extent satisfies both the income and the non-income based dimension of poverty.

The inclusion of non-monetary dimension has broadened the contemporary views on poverty and its related poverty measures, thereby recognizing the multidimensional characteristics of poverty. While it may be helpful to take a look at the multidimensional characteristics of poverty, the traditional income-based perspective of poverty, i.e. incidence of poverty, will be adopted as the basic poverty indicator for this research considering the very complex nature of finding the various determinants affecting multidimensional poverty characteristics.

## 2.2 Spatial Dimensions of Poverty

Analyst examining poverty and their causes generally seek individual or structural explanations (Crump, 1997). The individualist perspective tries to seek for explanation on differences in income and consumption of an individual. It focuses more on the human capital such as education, skills, etc., and do not attribute any causal significance to spatial inequalities in resource endowments. On the contrary, structural perspective also known as geographical models asserts that there exists a causal link between geography and the level of well-being. Local factors such as climate, soil type, infrastructure and access to services affect the condition of poverty of individuals living in a particular location. Poor resource endowments leads to limited access to educational, social and economic opportunities thereby further increasing the differences between poor and better-off areas.

Thus, empirical evidences suggest a strong relationship between geography and poverty. The case of Africa is one example. Because it has more land-locked geography and has fewer navigable rivers than almost any other parts of the world (except for Central Asia), distance is the main factor inhibiting its economic growth (Sachs and Warner, 1997). Similarly, the case of the northern region of Nigeria; the Indian states of Bihar, Orissa and West Bengal; the southern regions in Italy; and the Deep South of the United States where poverty incidence is higher than in other parts of their respective countries can be attributed to unequal distribution of natural resources (including water), differences in agro-climatic conditions, and differences in geographic conditions (primarily the distance to the centers of commerce, to the main transport routes, and to seaports) (Bigman and Fofack, 2000). Furthermore, there is some empirical evidence to defend the concept of spatial poverty trap. A case study or rural China supported the idea of spatial poverty trap (Jalan and Ravallion, 1997). A study of Ravallion and Wodon (1997) in Bangladesh also shows a significant structural geographic effect on living standards that are independent from household characteristics.

On this regard, geography cannot be regarded as a factor affecting poverty condition because it has a strong impact on the living standards of people living in the community especially in developing countries (Bigman and Fofack, 2000). As Glasmeier (2002), a distinguished human geographer in the United States, puts it "poverty is an inherently a spatial problem and that poverty policy has been largely uninformed about and often ignorant of the spatial meaning of poverty."

This implies that understanding poverty necessitates the incorporation of spatial factors to deepen our analysis of its patterns and unleash the undiscovered factors affecting its prevalence in order to find possible solutions to combat its persistence. In line with this, the next section reviews various methodological approaches in understanding and mapping poverty.

## 2.3 Poverty Mapping Approaches

"The importance of poverty reduction to the world development agenda has motivated greater interest in the geographic dimensions of poverty…" (Hyman *et al.*, 2005). The passage of the Millennium Development Goals sparked initiatives in the international arena to conduct poverty mapping exercises with several developing countries to support the fight against poverty. The challenge of many of these poverty studies is the lack of data at geographically disaggregated level. To solve this problem, experts from the World Bank and centers within the Consultative Group on International Agricultural Research (CGIAR) devised a robust statistical econometric methodology to estimate poverty at small areas (Bigman and Fofack, 2000). This is commonly known as small area estimation technique. This method relies heavily on census data which captures the total population of every individual and survey data containing household income and expenditure of a selected sample from the population. By combining these two datasets using an estimation parameter, poverty levels up to the lowest possible geographical subdivision, such as, a town, village, or community could be estimated. The results of the estimated poverty levels could then be presented in various thematic maps using GIS. This method has been employed by several poverty mapping studies conducted in developing countries such as Ecuador (Hentschel *et al.*, 1998), Madagascar (Mistiaen, 2002), rural India (Bigman and Srinivasan, 2002), Vietnam (Minot *et al.*, 2003; Minot and Baulch, 2005), Cambodia (Fujii, 2004), Morocco (Lanjouw, 2004), among others.

While small area estimation methodology employed sophisticated econometric models to map poverty at disaggregated levels, the Basic Needs approach utilized social based measures or indicators. The approach involves the selection of a certain number of variables that are non-monetary in nature to capture household well-being. This includes measures on nutrition, energy, sanitation and water, health and education. The strength of social indicators is that they provide a number of useful capability measures (Henninger, 1998). For example, anthropometric measurements such as child nutritional status i.e., low height and weight for age and low birth weight, could very well indicate the degree of development of a region and could be used as general proxy for constraints to human welfare of the poorest people (UN, 1992). In addition to social indicators, demographic based measures are also being employed as indicator to map poverty. These include gender, age structure of households and household size.

Lastly, the third approach to mapping poverty tried to seek the structural causes of poverty. Geographic factors could be one of the structural hindrances. This would include poor access to markets, infrastructure, transportation, resource endowment, limited access to land, environmental hazards, etc. The significance of poverty-environment mapping is to highlight spatial correlations and disparities in identifying the underlying causes and drivers of poverty. A growing number of studies notably in poverty and vulnerability mapping e.g., disasters, food security, health, crime, etc., also tried to underscore this approach. Moreover, some research initiatives sought to understand poverty and hunger with focus on mountain environments (Huddleston *et al.*, 2003) while others tried to establish the link between poverty and biodiversity loss (Snel, 2004), and ecosystem and human well-being (WRI, 2007).

On this regard, the use of GIS has become indispensable. For many studies, GIS has been used for the production of poverty maps as a result of small area estimation. But more that, GIS allows the simultaneously display of different dimensions of poverty and/or its determinants. The generated maps encourage visual comparison and make it easy to look for spatial trends, clusters, or other patterns. But more than a mapping tool, GIS could be used to generate spatial variables that might have an influence on poverty condition of communities. For instance, GIS could be utilized to extract information on agro-climatic suitability i.e., average rainfall, soil quality information, etc. GIS could also measure accessibility and proximity such as access to markets and service facilities which may also have an effect on the level of poverty. The spatial representation of poverty could therefore complement regression analysis to help us understand the influence of these determinants (Petrucci *et al.,* 2003).

## 2.4 Lessons from Previous Country Case Studies

What spatial factors affect poverty? Several researches tried to examine these in various country case studies. In 2002, poverty experts from the International Food Policy Research Institute based in Washington D.C. and Institute of Development Studies of the University of Sussex were commissioned to conduct a poverty study of Vietnam. In the said study, the small area estimation method (SAE) was adopted to estimate various measures of poverty and inequality for provinces, districts and communes of Vietnam (Minot, Baulch and Epprecht, 2003; Minot and Baulch, 2005). This was done by combining information from the 1997-98 Vietnam Living Standards Survey and 1999 Population and Housing Census. Subsequently, the study tried to correlate the results of poverty estimation method with geographic variables to determine the geographic determinants affecting poverty and inequality. Variables included agro-climatic and market access such as elevation, slope, soil type, land cover, hours of sunshine, rainfall and distance to towns and cities. By employing regression analysis, the study found out that agro-climatic variables and market access could be able to explain about three quarters of the variation in district-level rural poverty in Vietnam. Poverty is higher in district with sloped land, bare and rocky land-cover, soils that are poor (sandy, saline, or acid sulfate) and far from towns. The ability of agro-climatic variables to explain a large portion of differences in rural poverty rates indicated that poverty in the remote areas is linked to low agricultural potential and lack of market access. However these agro-climatic and market access variables could not explain urban poverty very well.

Similarly, a study in Nigeria adopted SAE as the methodology and, subsequently, regression of poverty and nutrition indicators against biophysical and socio-economic variables (Legg *et al.,* 2005). Spatial attributes such as land cover – percentages of tree cover, grass cover, bare soil, soil fertility, climate, and other socio-economic datasets were incorporated in the statistical analysis. The results showed that household livelihoods were strongly correlated with percentage of bare soil in the Eastern States of the country and in Taraba/Borno zone. Travel time to city markets is significant in Taraba/Borno zone while tree-cover, total population and annual rainfall are important in Kano/Kebbi zone. The percentage of bare soil could indicate both the area of land cleared for cultivation and the severity of soil erosion in the zone which could have connections with livelihood and poverty.

In Bangladesh, a study that tried to determine the spatial variation of rural poverty was undertaken by developing a variety of indicators representing various aspects of human welfare which may influence household's earning capacity and subsequently incidence of poverty (Kam *et al.,* 2005). These included household assets i.e., human and physical capital, natural capital, and opportunities for livelihood enhancements i.e., natural capital and access to facilities such as road and electrical infrastructure, educational and health facilities. GIS was used to derive a number of area variables and overlay biophysical maps (soil, land type and climate) with *upazila* boundaries. Moreover, GIS was used to compute for physical accessibility variables. By executing a regression analysis, said study found out that pockets of high poverty incidence generally coincide with ecologically poor areas for food production which are characterized by prevalence of high land, low and very low-lying land and heavy textured soil types. Other livelihood influencing factors were education, accessibility and services.

On the other hand, a study in Sri Lanka tried to map the spatial clustering of poverty and analyzed the factors contributing to its spatial concentration (Amarasinghe *et al.,* 2005). Variables used included availability of and access to water, land, employment, and infrastructure facilities. An ordinary least square (OLS) regression method was employed to assess the influence of the above factors on the incidence of poverty and its spatial clustering at the Divisional Secretariat (DS) level. The result of the study showed a significant clustering of poor and non-poor areas. High percentage of poor households was found in rural districts where agriculture is the main source of livelihood for the majority of households. The study concluded that availability of and access to water and land resources are the major factors of spatial concentration of poverty in rural areas in Bangladesh.

A study in Southern Kenya identified and mapped out critical spatial factors which largely determine livelihood options, strategies and welfare of agro-pastoral communities in semi-arid district (Kristjianson *et al.,* 2005). These were grouped into natural, human, social, financial and physical capital assets. Using high-resolution spatial poverty data coupled with participatory land-use mapping methods to build the datasets, the study employed a loglinear Poisson regression model to examine the spatial correlates of community-level poverty incidence. As a result, said study found that pasture potential, livestock density, distance to a major town, road density, access to education, access to security, soil fertility and agricultural potential are the major determinants of poverty in Kenya.

On another study, in Malawi, the key spatially explicit determinants of poverty variations were identified using about 17 spatially derived variables (Benson *et al.,* 2005). By employing a geographically weighted regression analysis, it was found out that the most important determinant to poverty in Malawi is travel time to the nearest hospital which is a proxy of access to district-level services.

In summary, these studies underscored the role of geography as key determinants of poverty. Most of the studies found out that topography, soil characteristics, rainfall, road access, distance to cities, etc. are proved to be explanatory factors of poverty (Hyman *et al*., 2005). We can adopt several of these variables on our analysis of poverty in one of the case study area in the Philippines.

## 2.5 Poverty Studies in the Philippines

This section discusses some of the poverty mapping and related studies that have been done in the Philippines. Balisacan *et al*. (cited in Domingo, 2003) conducted a study of poverty which focused on developing variables that are closely linked to poverty income measures with the end in view of identifying proxy indicators. Using Ordinary Least Squares (OLS) regression method, they identified some correlates, which are mostly household characteristics and subsequently generated composite indices, the results of which became the basis for ranking municipalities by the Department of Social Welfare and Development (DSWD) in its poverty alleviation program.

Similarly, Albert and Collado (2004) investigated how a particular factor affects the poverty situation on the level of other potential poverty determinants using data from the CY 2000 Family Income and Expenditure Survey. By performing a multiple regression analysis, they found out that poverty status was very much related to housing characteristics. The research suggested further investigations of poverty in the Philippines such as generation of small area estimates of poverty and incorporation of geo-reference data using GIS which were not considered in their study.

While the abovementioned study focused more on the household characteristics as predictors of poverty incidence, Kainuma (2004), on the other hand, tried to look for the causes of regional differentials in the Philippines. Using regression analysis, she found out that there is a distance decay relationship between regional income standards and the proximity to Metro Manila. This can partly be explained by the fact that the metropolitan area where the central managerial function is concentrated possesses high potential to attract private investments; hence, high quality infrastructures are in placed. The geographical bias of the government in terms of budgetary allocation is concentrated to areas with high economic efficiency such as Manila compared to areas far from the nation's capital. This would imply that geographical distance from the center to the periphery could be a factor of underdevelopment of a particular region, province or locality.

Moreover, a few years ago, the World Bank commissioned poverty experts to conduct a poverty mapping exercise that would estimate local poverty in the Philippines (NSCB, 2004). Using hybrid small area estimation technique, poverty incidence, gap and severity were estimated by combining household characteristics of the CY 2000 Family and Income and

Expenditure Survey (FIES) with CY 2000 Census of Population and Housing (CPH). Results of the study for the whole country were officially released by the National Statistical Coordination Board in 2004 on a report entitled "Local Estimates of Poverty in the Philippines." For the first time in the history of Philippine poverty statistics, municipal-level poverty estimates were produced for the whole country. These poverty estimates could be tapped to serve as the basic indicator of poverty condition and which would be useful in overlaying geographic, social and economic indicators at a more disaggregated level (NSCB, 2005). Thus, this research will adopt the poverty estimates generated based from this study to serve as the basic poverty indicator at the local level.

Although the abovementioned studies have contributed to the body of knowledge and information on Philippine poverty condition, there is a need to further investigate the spatial dimension of poverty, which has not been taken greater attention by previous studies mentioned above, in order to deepen our understanding of its patterns and determinants.

## 2.6 Conceptual Framework

Based from the preceding discussion, this research builds a framework which will serve as the overarching guide to explore the spatial patterns and determinants of poverty. This framework is best represented by a diagram found in Figure 1. First, according to the literature, poverty has a spatial dimension which is often neglected in many studies; thus, this shall be underscored particularly in exploring the possible spatial determinants. This spatial aspect is the physical environment or the geography (represented by the first circle) which may have an influence on the poverty condition of places or region. Under this dimension, two major groups of variable were identified – the natural resource endowments and access and proximity. Natural resource endowments would basically refer to agro-climatic conditions that are naturally present within an area or region. This would include elevation, slope, soil, rainfall and river access, all of which may have an influence on the persistence of poverty especially for an agriculture-based economy such as the Philippines. The second group called access and proximity would point to geographical infrastructure that is man-made in nature such as access to road and proximity to major markets.

Apart from the physical environment, the possible effect of government policies on the condition of poverty which according to literature is an important factor of poverty is considered in the analysis. Herein, two major policies of the Philippine government were identified – the land distribution program which is a poverty alleviation program aimed to uplift the lives of landless farmers nationwide; and the fiscal decentralization policy which is a strategy of the national government to deconcentrate development away from major cities such as Manila towards the regions and the countryside through funding support for local development. Lastly, the possible effect of population growth to poverty is also considered. Higher growth of the population would mean that more children are being born, hence, greater financial burden on the part of the working sector to provide basic life necessities for them. Thus rapid population growth is normally viewed as contributory to the persistence of poverty in the Philippines (Balisacan, 2007).

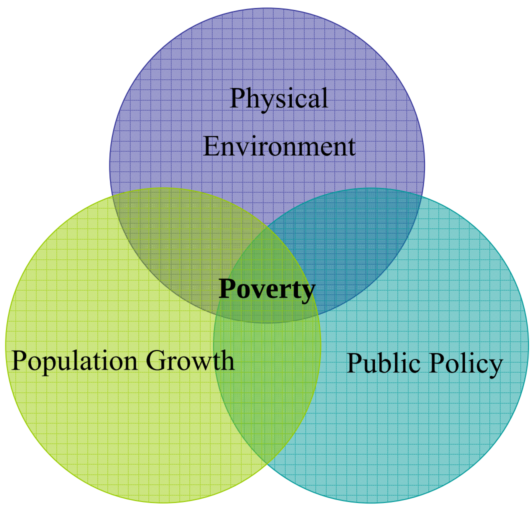



**Figure 1: Conceptual framework**

The socio-economic factors such as education, household size, employment and other household characteristics were not included in the analysis because these aspects were already captured by the previous study of World Bank in estimating for poverty incidence at the municipal level. Hence, poverty incidence, which shall serve as the basic indicator of poverty, could be considered a socio-economic condition by itself.

The table below enumerates and summarizes the key components and variables to be examined in this research. Meanwhile, the next chapter describes the selected study area to implement this research – the Bicol Region and its two provinces – Albay and Camarines Sur.

**Table 1: Operational framework**

| Dimension | Sector | Variables |
|---|---|---|
| **Poverty condition** | Socio-economic | Poverty incidence |
| **Physical environment** | Natural endowment – Agro-climatic condition | Elevation |
| | | Slope |
| | | Soil |
| | | Access to river |
| | | Rainfall |
| | Access and proximity | Access to road infrastructure |
| | | Proximity to major markets |
| **Public policy** | Influence of government programs and policies | Land distribution |
| | | Fiscal decentralization |
| **Population growth** | Population | Population growth |

# Chapter 3

# The Study Area: Albay and Camarines Sur Provinces in Bicol Region, Philippines

This chapter describes the general physical and socio-economic condition of the selected study area – the two adjacent provinces of Albay and Camarines Sur located in Bicol region - in order to give a glimpse of its condition which could aid in understanding poverty in this region in general, and in the two provinces, in particular. These two provinces were selected because they are located in one of the poorest regions in the country. Moreover, they have almost the same topography compared to other provinces in the region and they share a common boundary.

## 3.1 The Bicol Region and its Poverty Situation

Located at the midsection of the country at the southern tip of Luzon Island, Bicol is one of the 16 administrative regions in the Philippines. It is composed of four (4) mainland provinces (Camarines Norte, Camarines Sur, Albay, and Sorsogon) and two (2) island provinces (Catanduanes and Masbate). On the northwest, it is bounded by Quezon Province, east by the Pacific Ocean, southeast by Samar Sea and southwest by Sibuyan Sea.

Bicol is one of the poorest regions in the country for the last fifteen years. In 1985, Bicol topped the rank in terms of poverty incidence. When the Autonomous Region for Muslim Mindanao (ARMM) was created, Bicol played second among the poorest regions from 1994 onwards (see Table 2). Although poverty incidence slightly declined from 1995 to 2000, studies found out that number of the poor have actually increased (Reyes and Valencia, 2004). In CY 2000, approximately 62% of the population lived below the poverty line in Bicol region which is 12% higher than the national average of 40%.

**Table 2: Poverty incidence of the population by region, 1985 - 2000**

| **Region** | **Year** | | | | | |
|---|---|---|---|---|---|---|
| | **1985** | **1988** | **1991** | **1994** | **1997** | **2000** |
| Philippines | 49.2 | 45.4 | 45.2 | 40.6 | 36.9 | 39.5 |
| NCR | 27.1 | 25.1 | 16.6 | 10.4 | 8.5 | 11.5 |
| 1 – Ilocos | 43.4 | 51.7 | 55.1 | 53.5 | 44.2 | 43.6 |
| 2 – Cagayan Valley | 42.7 | 44.7 | 48.9 | 41.9 | 38.0 | 35.0 |
| 3 - Central Luzon | 32.0 | 33.7 | 35.5 | 29.2 | 18.6 | 23.0 |
| 4 – Southern Tagalog | 45.7 | 46.6 | 43.1 | 35.0 | 30.0 | 31.0 |
| **5 – Bicol** | **67.5** | **61.3** | **61.2** | **60.8** | **57.0** | **61.9** |
| 6 - Western Visayas | 66.4 | 56.5 | 52.8 | 49.8 | 45.9 | 51.1 |
| 7 - Central Visayas | 61.9 | 52.1 | 46.7 | 37.4 | 39.0 | 43.8 |
| 8 - Eastern Visayas | 65.1 | 54.7 | 47.1 | 44.6 | 48.5 | 51.1 |
| 9 - Western Mindanao | 59.9 | 43.8 | 54.2 | 50.5 | 45.5 | 53.0 |
| 10 - Northern Mindanao | 56.6 | 50.1 | 57.4 | 54.2 | 52.7 | 52.2 |
| 11 - Southern Mindanao | 49.6 | 48.8 | 51.5 | 45.4 | 44.3 | 45.1 |
| 12 - Central Mindanao | 56.3 | 40.9 | 63.0 | 58.5 | 55.8 | 58.1 |
| CAR | . | 50.5 | 55.5 | 56.5 | 50.1 | 43.8 |
| ARMM | . | . | 56.0 | 65.5 | 62.5 | 71.3 |

*Source of Data: 1985-2000 Family Income and Expenditures Survey, NSO*

*Adopted from: (Reyes and Valencia: 2004, 4)*

## 3.2 The Case Study Area

The selected case study area involves two provinces, namely, Albay and Camarines Sur. Both are located in the central part of Bicol mainland. These two provinces composed of 55 local government units (LGU) (see Map 1). Two of these LGUs are considered major cities – Naga City and Legaspi City – with more than 100,000 population each and revenue exceeding an average of 200 million for the past 5 years from 1996 - 2000. Legaspi City serves as the regional capital while Naga City is classified as an independent highly urbanized city. The two cities are famous and serve as the center of regional economy. Also, there are three minor cities – Iriga City, Ligao City and Tabaco City – serving as small local cities while the remaining 50 LGUs are classified as municipalities. All of these LGUs are further subdivided into 1,763 *barangays*, the smallest sub-political unit in the Philippines. However, the basic local governance where local power and authority resides is in every local city or municipal government and not within the *barangay* system. Hence, for the purpose of this research and also considering the limited data available at disaggregated level, the unit of analysis would be the city/municipality level.

### 3.3.1. Physical Condition

The case study area is endowed with rich reserve of natural resources for agricultural and economic activities. Total land area is 8,047.5 sq. km. which is 45.6% of the total area of the Bicol Region. A strip of mountain-volcanoes cuts across this area while rolling hills and terrain comprised the eastern and western part. Mayon Volcano located in the southeastern part dominates the landscape with its perfect cone crater. Other major mountains that cover the area include Mount Isarog located near Naga City and Mount Asog which is found in the midsection of these two mountain features (see Map 2).

The midsection of this area forms an elongated valley comprising of flat alluvial lands. Network of rivers, streams and creeks traversed the Bicol plain which serve as a natural drainage and are adjoined by three fresh water lakes – Lake Buhi, Lake Bato and Lake Baao. As such, water from these bodies which flows across the plain have formed the so called Bicol River Basin which comprises fertile agricultural lands including watershed area. The principal tributary of the basin is the Bicol River which is the largest in the region with an approximate length of 95 kilometers. Its outlet begins at Lake Bato and flows northwesterly through the floodplain. The northern part of the basin is drained by the Libmanan-Sipocot River which flows southeasternly through hilly terrain to join with the Bicol River near its mouth and is discharged all the way to San Miguel Bay.

The climate in the study site is divided into two types: Type III and Type IV. Albay's climate is generally characterized by no pronounce maximum rain period with a short dry season (Type III). On the other hand, Camarines Sur encounters evenly distributed rainfall throughout the year (Type IV).

This area is accessible by air, by land or by sea. Legaspi and Naga Domestic Airports serves as the gateway of the regional mainland to and from Manila. Buses ply daily from Manila to Bicol mainland via the Quirino Highway and Maharlika Highway. An existing railway also operates and offers regular trips to Naga City and Legaspi City from Manila. Intra-regional ferries/pumpboats ply from Tabaco City to Virac, Catanduanes, Tabaco City to San Andres, Catanduanes and Legaspi City to Rapu-rapu Island.

### 3.3.2. Socio-economic condition

The population of the study area as of CY 2000 is 2.64 million comprising of 496,812 households, which is 57% of the total Bicol regional population (Table 3). The average household size is five (5) members per family. Population density is about 328 persons per square kilometer, slightly higher than the regional population density of 265. This means that the Bicol regional population is highly concentrated in the two provinces particularly its midsection and some coastal areas (see Map 3).

In terms of Human Development Index (HDI), Albay and Camarines Sur scored 0.541 and 0.558, and ranked 44 and 34 among the rest of the provinces in the country, respectively (Table 4). In other words, the two provinces are not lagging behind the rest in human development, yet the region remains one of the poorest in the whole country.

**Table 3: Total population, number of households, average household size, population growth rate, land area, and population density as of CY 2000**

| Province | Total Population | No. of Households | Average Household size | Annual Pop. Growth 1995-2000 | Land Area (sq. kms.) | Population Density (persons/sq. km.) |
|---|---|---|---|---|---|---|
| Albay | 1,090,907 | 208,640 | 5.22 | 1.77% | 2,565 | 425 |
| Cam. Sur | 1,551,549 | 288,172 | 5.37 | 1.72% | 5,482 | 283 |
| Total (2 provinces) | 2,642,456 | 496,812 | 5.32 | No data | 8,047 | 328 |
| Total (Bicol) | 4,674,855 | 891,541 | 5.24 | 1.68 | 17,632 | 265 |

*Source: National Statistics Office (NSO) Region V*

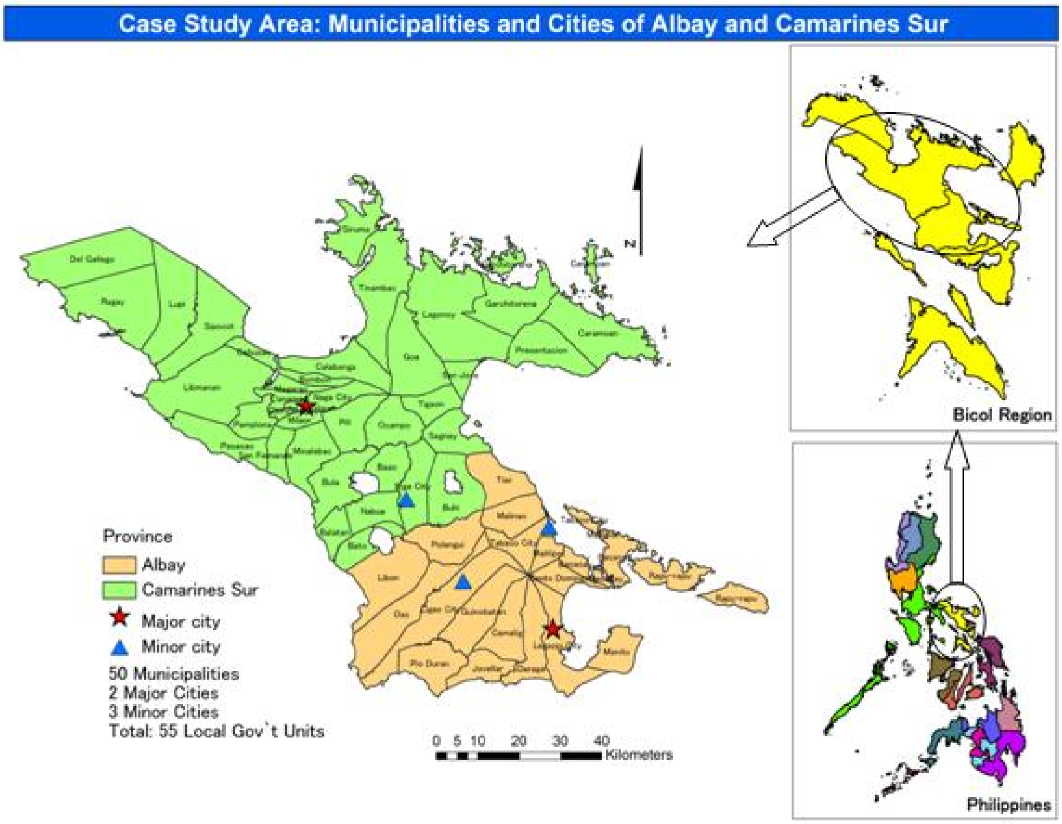
**Table 4: Human Development Index by component CY 2003**

| Province | Human Dev't Index (HDI) | Life Expectancy | | Education | | Income | | Nat'l Rank | Per Capita Income Rank Minus HDI rank |
|---|---|---|---|---|---|---|---|---|---|
| | | Level (years) 2003 | Index | % of HS graduates 18 yrs. Above 2003 | Index | Per Capita Income (pesos) 2003 | Index | | |
| Albay | 0.541 | 69.0 | 0.733 | 47.6 | 0.623 | 18,129 | 0.267 | 44 | 19 |
| Cam. Sur | 0.558 | 71.3 | 0.772 | 42.4 | 0.574 | 20,477 | 0.327 | 34 | 9 |
| **Ave.-Bicol** | **0.520** | - | **0.711** | - | **0.572** | - | **0.279** | - | - |

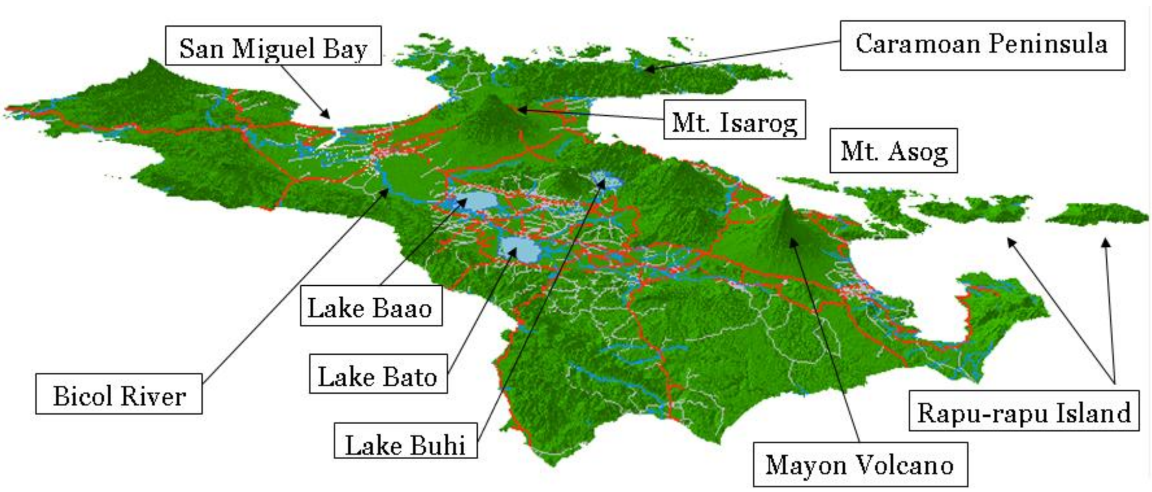
*Source: National Statistics Office (NSO) Region V*

Results from CY 2000 Family and Income Expenditure Survey (FIES) reveal that the average family income in this region is Php 89,277 which is far below the Php 144,039 national average. Poverty threshold in CY 2000 was set at Php 11,525 per capital per annum (Approximately JPY 20,000 per year per person).

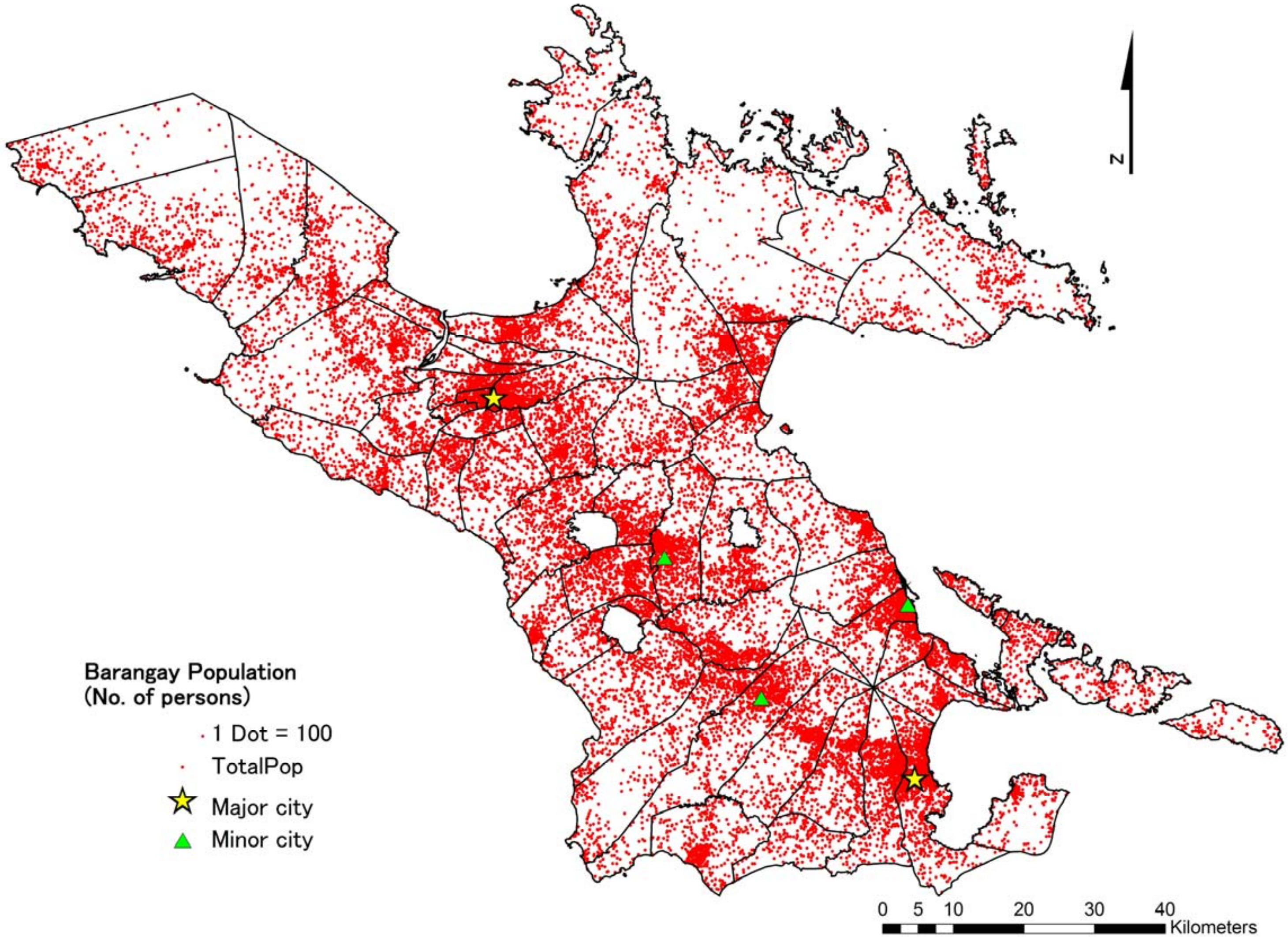
In general, the region contributes about 7 percent to national palay production; 21 percent to national coconut production; and 25 percent to national abaca production. It is also the second major cassava-producing region in the country. Despite so, food sufficiency (supply vs. demand) and productivity (yield per hectare) levels remain low according to the National Economic and Development Authority (NEDA) Bicol Regional Office. Traditional exports include copra, abaca fiber, and coconut oil. Non-traditional exports include home furnishings, gifts, holiday decor, wearables, and marine products.




**Map 1: Location of the case study area**




**Map 2: Topographic features and landscape of the case study area**




**Map 3: Spatial dot density distribution of the population in CY 2000**

# Chapter 4

# Methodology for Exploring the Spatial Patterns and Determinants of Poverty

This chapter deals exclusively on the methodology for mapping the various indicators of poverty and spatial analysis that have been executed to derived spatial variables to serve as possible determinants of poverty in the selected study site. First, the various data collected during fieldwork will be presented. Subsequently, pre-processing and database build-up activities shall be discussed. Then, the type of spatial analysis for each spatial variable will be accounted in detail. Finally, the statistical analysis i.e., multivariate regression analysis employed in this study will be explained.

## 4.1 Data Collection

In line with the conceptual framework presented in chapter 2, the following data were gathered in the field from different units of the national government and respective agencies in Bicol Region. As mentioned in the preceding chapter, local poverty incidence was obtained from a previous study conducted by the Philippines' National Statistical Coordination Board (NSCB) in collaboration with the World Bank - Asia-Europe Meeting (WB-ASEM) Project. Poverty incidence at every city/municipality, which was not available in the past, was computed by NSCB based on a robust econometric model combining the characteristics of CY 2000 Family and Income Expenditure Survey and CY 2000 Census of Population and Housing.

On the other hand, the collection of spatial data in the Philippines is quite difficult, especially those in GIS or raster format. More so, most of the spatial data suffers from data quality because there are no existing standards and protocols for production and sharing of geospatial data. On this regard, all possible sources of data were explored to fill data gaps. Table 5 shows all of the collected geo-spatial datasets for the study. Elevation values were collected from satellite imageries of the recently released Shuttle Radar Topographic Mission (SRTM) version 3 (Jarvis *et al.,* 2006). The imageries have a 90-meter resolution. Landsat ETM imageries were also acquired from Global Land Cover Facility (GLCF) to serve as reference point to assess the quality of other spatial datasets (NASA Landsat Program, 2003). Fortunately, soil data was obtained from the Bureau of Soil and Water Management (BSWM) in shapefile format. Very detailed administrative boundary, river and road network were taken from Cybersoft Geoinformatics, Inc., a private GIS consultancy company that is engaged in mapping and geospatial data building activities in the Philippines. Average annual rainfall values, on the other hand, were collected from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

**Table 5: Matrix of geo-spatial datasets**

| Data | Year | Note | Source |
|---|---|---|---|
| Poverty Incidence | CY 2000 | Based from Small Area Estimation Method | Philippines' National Statistical Coordination Board, - World Bank ASEM Project |
| Administrative Boundary | CY 2000 | By province, municipality & *barangay* | Cybersoft Integrated Geoinformatics, Inc. |
| Elevation | CY 2000 | 90 meter resolution | Shuttle Radar Topographic Mission (SRTM) |
| Soil | | By texture type | Philippines' Bureau of Soils and Water Management (BSWM) |
| River network | | Polylines | Cybersoft Integrated Geoinformatics, Inc. |
| Rainfall values | CY 2000 | Total annual values | Philippine Atmospheric, Geophysical and Astronomical Services Administration |
| Road network | | By road type (major/minor road) | Cybersoft Integrated Geoinformatics, Inc. |
| Landsat ETM | Aug 2001 and Oct. 2001 | 30 meter resolution | Global Land Cover Facility Zone 114 Path 51 & 52 and Zone 115 Path 51 and 52 |
| Agrarian Reform | CY 2000 | By municipality | Department of Land Reform – Bicol Regional Office, Legaspi City |
| Internal Revenue Allotment | CY 2000 | By municipality | Department of Budget and Management, Regional Operations and Coordination Service |
| Population Growth | 1990 - 2000 | By municipality | Philippines' National Statistics Office |

The status of the implementation of the Comprehensive Agrarian Reform Program (CARP) which best represents the state of land distribution in the country was collected from the regional office of the Department of Land Reform in Legaspi City. For fiscal decentralization component, the share of Internal Revenue Allotment (IRA) of every cities and municipalities within the study provides the best indicator for this variable. Such data was obtained from the Department of Budget and Management (DBM) central office in Manila. Lastly, data on population growth for the past 10 years from 1990 to 2000 was collected from the National Statistics Office (NSO).

## 4.2 Pre-processing

The datasets gathered from this study consist of two types – the spatial and non-spatial. For spatial datasets, appropriate pre-processing techniques had to be done. These included digitizing and georeferencing of imageries and shapefile in the same map projection. All of the spatial datasets were projected in Universal Transverse Mercator (UTM) Zone 51 North. Moreover, the projected shapefile data such as administrative boundary, river and road network were compared with the Landsat imageries to assess their quality and reliability. In some cases, additional polylines of roads were digitized based from the visible road in the Landsat imageries to update the road feature dataset. The boundaries of the inland lakes were also digitized to delineate them from the land borders. On the other hand, negative elevation values, which denotes ocean, were deleted from the SRTM raster.

## 4.3 Geospatial Database Build-up

The administrative boundary shapefile was used as the basic spatial data to incorporate the attributes of the feature dataset. A unique identifier for every city/municipality boundary is required to establish a spatial link between the two. For this purpose, the Philippine Standard Geographic Code was adopted as the unique identifier. It consists of 8 digits. The first 2 digits refer to the regional number; the next 2 digits pertain to the provincial code while the last 4 digits refer to the municipal code. Example of this is as follow: 50506000

| | | |
|---|---|---|
| Regional code | - 50 | (Bicol) |
| Provincial code | - 50 | (Albay) |
| Municipal code | - 6000 | (Legaspi City) |

In the same way, the non-spatial data such as poverty incidence, agrarian reform, IRA and population growth had to be encoded using MS access. Each entry was assigned with a unique identifier based on its corresponding city/municipality location. Subsequently, all of these data were spatially joined with the administrative boundary layer using ArcGIS 9.1.

## 4.4 Spatial Analysis

Using the capability of ArcGIS 9.1, the study employed several spatial analyses on each of the spatial datasets – elevation, soil, river, road and rainfall - in order to generate auxiliary datasets that could be disaggregated by municipality. Specifically the results of the GIS-derived variables were later associated with poverty incidence to explore the spatial determinants affecting poverty in the case study area. The method of how each of the spatial variables was derived is accounted in detail in the next subsection.

### 4.4.1 Zonal Analysis

Elevation values are recorded in raster format. Using the administrative boundary shapefile as the zonal border, a zonal statistics was executed using Spatial Analyst extension in ArcGIS 9.1 in order to extract the mean elevation values by municipality. In this analysis, as well as in the succeeding zonal analysis of other spatial datasets, the three lakes were excluded as part of the administrative boundary because these have an area bigger than the smallest municipality; hence, they may affect the generated mean value of every variable, especially the municipalities where they administratively belong.

Meanwhile, the slope gradient in percent was extracted using the same elevation values from SRTM. Thereafter, the generated slope values were manually classified into seven (7) categories in accordance with the Global Agro-ecological Zone (GAEZ) mapping classification of the Food and Agricultural Organization of the United Nations (FAO) (Fisher *et al.*, 2000), as follows: 1) 0 to 2% - flat; 2) 2 to 5% - gently sloping; 3) 5 to 8% - undulating; 4) 8 to 16% - rolling; 5) 16 to 30% - hilly; 6) 30 to 45% - steep; and 7) above 45% - very steep.

Since the interest of this study is to determine the effect of slope as an agro-physical condition to poverty, slopes which have agricultural limitations were defined: slope 0 to 8% were labeled as slope with no agricultural limitations because they are most likely suitable for farming and possess no irrigational constraint whereas slope above 8% suffer from agricultural restraint. Similarly this criterion was based from GAEZ mapping by FAO (Fisher *et al.*, 2000).

With respects to soil, the attributes of the soil dataset obtained from BSWM consists of 37 different soil textural properties which are further classified by soil suborder series. To delimit this classification, soil attributes were grouped by texture type as follow: 1) Clay, 2) Silty Loam; 3) Clay Loam; 4) Sandy Clay Loam; 5) Loam; 6) Silt Loam; 7) Fine Sandy Loam; 8) Fine Sandy Loam, stony phase; 9) Gravelly Sandy Loam; 10) Sand; 11) Mountain Soil; 12) Complex; 14) Hydrosol; and 15) Lava Flow.

Thereafter, using Zonal Statistics in ArcGIS 9.1., the percentages of different soil texture types classified above were computed by city/municipality. Then, the types of soil which have agricultural limitations were classified. According to GAEZ (*Fisher et al.*, 2000), soil with medium and fine textures have no constraints and are suitable for farming activities. These soil types include: 1) Clay; 2) Silty Clay Loam; 3) Clay Loam; 4) Sandy Clay Loam; 5) Loam; 6) Silt Loam. The rest possess coarse texture which have agricultural limitations. The percentages of soil with and without constraints were then computed by municipality.

### 4.4.2 Kriging Interpolation and Zonal Analysis

The inclusion of rainfall data in this study posted a challenge in this research because Philippines weather data are not disaggregated by municipality since the government does not have weather observation facilities in every locality. In the case of the study area, there is only one observation facility located in Legaspi City, Albay.

To solve this data problem, annual rainfall data of 13 weather stations located within the vicinity of Bicol Region were collected (see Appendix 2). CY 2000 served as the reference point because local poverty incidence was estimated by NSCB from CY 2000 Census and Income/Expenditure Survey. Then, the location of each weather station was plotted and georectified using their respective latitude and longitude coordinates. The corresponding annual rainfall values recorded from each weather station were linked with their plotted spatial location. Thereafter, the values in between the plotted points were estimated using kriging method, a geostatistical technique often used to interpolated climate fields. Kriging method was used because it is one of the most appropriate spatial interpolation methods to estimate rainfall values (Biau *et. al.*, 1998). After interpolating for the rainfall values, a zonal analysis was executed using administrative boundary as zones in order to generate the mean annual rainfall for every city/municipality which could eventually be correlated with local poverty incidence.

### 4.4.3 Density Analysis and Zonal Analysis

In this study, the effect of river in poverty condition was considered primarily because proximity to river could serve as a source of agricultural irrigation or fishing livelihood. Using the very detailed polyline dataset, a line density analysis was performed using ArcGIS 9.1 Spatial Analyst to derived river density that could represent access to river. Subsequently, the mean river density by municipality was computed using Zonal Analysis to allow for comparison with poverty data.

Aside from the preceding variables which represent natural resource endowment, the effect of access to existing road infrastructure to poverty condition had to be analyzed. Although the concept of access to road infrastructure alone has a lot of dimension which could include transportation and hauling cost, travel time as well as effect of road pavement types to the accessibility of people, goods and services, in this particular study, it simply means physical access since data on cost, travel time and pavement type by road segment is unavailable.

On this regard, the very detailed road polyline dataset was utilized as the basic dataset in this study. Similar to river polyline, a kernel density analysis using Spatial Analyst was performed to derive the road density. However, major roads were given greater weight in the computation of density in order to include the effect of road types to poverty. Subsequently, a zonal analysis was employed to generate the average road density by city/municipality.

### 4.4.4 Network Analysis

Last but not the least among the spatial variables is proximity to major markets which could be represented by distance to major cities. To estimate the distance, several parameters had to be defined. First, the center of every municipality had to be located. Two options could be possible. One is the geographical center of each polygon while the other one is the location of town center. In this study the latter one was adopted because town center locations serve as the center of economic, political and cultural life of every municipality. The location of each town center represents their link and relationship with major cities where there is a massive concentration of regional economic activities.

As discussed in the previous chapter, Naga City and Legaspi City serves as the two major economic centers in the region. Together with the remaining LGUs, their respective city/town centers were pinpointed using a series of procedures. First, barangays named as *Poblacion,* a Spanish term for the word "capital" were identified in every LGU from the *barangay* boundary layer. In some cases, more than one *Barangay Poblacion* exists in every locality, but nonetheless, they are adjacent to one another. To locate the center of each locality, road polyline dataset and Landsat imageries were overlaid with the *barangay* boundary layer to search for the area where there is high concentration of streets and intersections. As a result, a point layer data consisting of 55 city/town centers were detected.

To estimate the distance of each town center to the nearest major city, a road network dataset was built from the existing road polyline dataset using Network Analyst extension in ArcGIS 9.1. The connections of nodes, arcs, and lines in the road network dataset had to be checked. Thereafter, a network analysis was executed by using closest major facility function. The city centers of the two major cities were assigned as "facility" and each town center as "incidents." Distance of each town center to a major city was estimated based from the existing road network dataset.

Exception to this analysis is the island of Rapu-Rapu in the southeastern part of Legaspi City due to its isolation from the road network. Since, the concern of the study is proximity to major markets in terms of physical distance, the distance of this island was simply measured by drawing a direct line from its local port located in its *Poblacion* to Legaspi City center, which is close to the city port. This line also could represent the average estimated Euclidean distance traveled by small boats from the city port to Rapu-rapu's port which is the only means of transportation to access this island. In summary, the table below shows the different spatial variables which were derived from existing spatial data employing appropriate spatial analysis using GIS.

**Table 6: Matrix of GIS-derived spatial variables**

| Group | Variables | GIS-derived indicator |
|---|---|---|
| Agro-climatic condition | Elevation | Mean elevation |
| | Slope | Percentage of Slope with and without agricultural constraints |
| | Soil | Percentage of Soil with and without agricultural constraints |
| | Access to river | Mean River density |
| | Rainfall | Mean annual rainfall |
| Access and proximity | Access to road Infrastructure | Mean Road density |
| | Proximity to major markets | Nearest estimated distance to major cities |

## 4.5 Multivariate Regression Analysis

After performing a series of spatial analysis for the different spatial variables to derive auxiliary data that would be comparable with poverty incidence in every locality, a multivariate regression analysis was performed together with the non-spatial datasets. Multivariate regression was adopted because it has the capability to test all of the possible factors that affects a single phenomenon - poverty. In this case, the physical environment, access and proximity together with the influence of policies and population growth served as the independent variables in the regression model while poverty incidence which represents the condition of poverty of every locality stood as the dependent variable.

An existence of collinearity had to be check for every variable using bivariate correlation analysis to ensure that they are independent with one another (see Appendix 1 for the correlation matrix) To avoid redundancy of every variable such as slope and soil texture characteristics, only one entry for every variable which has the highest correlation was included in regression computation. The full regression model can be mathematically stated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 + X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \varepsilon$$

Where: Y = Poverty
$\beta_1$ to $\beta_{10}$ = coefficients
$X_1$= Elevation
$X_2$= Slope
$X_3$= Soil
$X_4$= Rainfall
$X_5$= River Access
$X_6$= Road Access
$X_7$= Proximity to major cities
$X_8$= Agrarian Reform
$X_9$= Fiscal Decentralization Policy
$X_{10}$= Population growth
$\varepsilon$ = Error

The nature of each variable in the regression model is presented below. Most of the variables are expressed in percentage. Results of the regression were related with other secondary data to elucidate the possible reasons explaining the spatial variation in poverty.

**Table 7: List of variables used in regression analysis**

| Code | Indicators | Description |
|---|---|---|
| incidence | Poverty Incidence | In percent |
| e_mean | Mean Elevation | In meters |
| sl8up | Slope above 8% | In percent of total area |
| Soil-c | Soil with constraint | In percent of total area |
| rainmean | Mean Annual Rainfall | In millimeters |
| evldmean | Mean River Density | In sq. m./sq. km. |
| roadkmn | Mean Road Density | In sq. m./sq. km. |
| Dist_mjc | Distance to major cities | In kilometers |
| carpac00 | Agrarian reform accomplishment rate | In percent |
| Irashare | Internal Revenue Allotment share | In percent of total amt. for 2 provinces |
| growth2K | Population growth (1990 to 2000) | In percent |

Below is a diagram that summarizes all the steps and procedures that have been done in this research and expected outputs of the study. The next chapter discusses in detail the results of the analysis as applied in the selected study site.

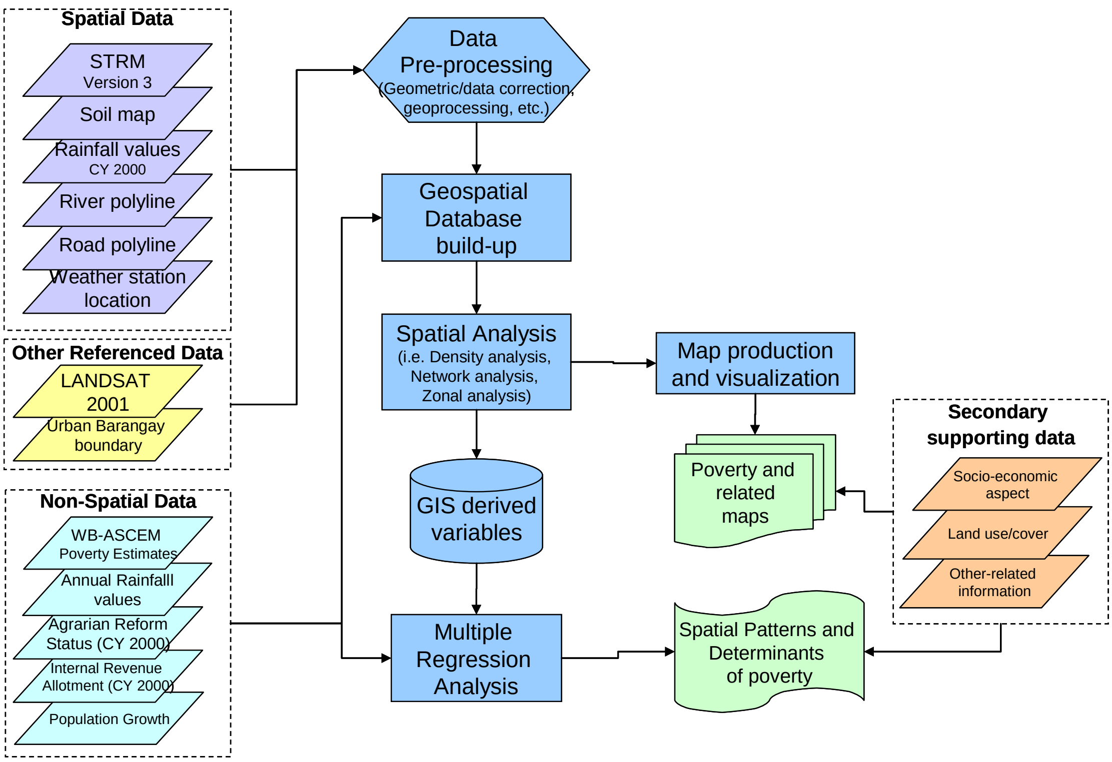



**Figure 2: Diagram of research methodology using GIS**

# Chapter 5

# Spatial Patterns and Determinants of Poverty

This chapter presents the empirical results of the study – the spatial patterns and determinants of poverty – as applied in Albay and Camarines Sur provinces. Before presenting the spatial patterns of poverty, socio-economic attributes are presented, specifically, the age structure and educational attainment characteristics, since these were considerably important when the NSCB and WB estimated local poverty incidence, the dependent variable in this study. Thereafter, the chapter presents each variable and their correlation with poverty. Maps and charts were prepared to enhance the discussion. Subsequently, the latter part of chapter presents an integrated analysis of the results generated from the multiple regression analysis. Related secondary data are presented from time to time to further explain the possible causes of poverty.

## 5.1 Spatial Patterns of Poverty and Related Characteristics

Demographic structure of the population is an important aspect to consider in exploring the spatial patterns of poverty in so far as poverty is related to people's attributes. Although, the emphasis in the study is not on "people poverty", but on "place poverty," it is worthwhile to show the demographic characteristics of the population to shed light on understanding poverty patterns.

The age of the population in the study site is relatively young. The pyramid-like structure in Figure 3 shows that the child and adolescent consist of a mass of the total population whereas the adult who are the working class decreases with the age ladder. Overall, the minor (below 15 years old), ageing (above 65 years old), and productive (15 to 65 years old) population comprise 40%, 4% and 56%, respectively (see Figure 4).

Meanwhile, the spatial distribution of the population by age group is presented in Map 4. A greater number of the productive population lives in the cities although it is also relatively high in some parts of the countryside. When dependency ratio is computed by adding the minor (below 15 years old) and ageing population (above 65 years old) and dividing its total against the productive population (15 to 65 years old), the map shows that dependency ratio is lowest in major cities and some adjacent areas whereas it is extremely high in areas like – Caramoan Peninsula and Rapu-rapu Island. These areas have an average dependency ratio of one (1.0) which means that a single person belonging to the productive age group needs to support one dependent child or elderly. In other words, there is a great burden to satisfy food and other basic needs of dependents by the working class in these areas than in the cities and their peripheries.

Education is also considered as one of the important aspects related to poverty. High education would most likely lead to a better employment, thus, higher compensation, and therefore, less chance of being poor. To present this aspect, the educational characteristics of the labor force population were extracted from the CY 2000 Census database.

Figure 5 shows the highest educational attainment of the labor force population in CY 2000. Forty one (41) percent of them have completed at least elementary school while 36% have finished at least high school. Those who graduated from a post-secondary or vocational training (similar to College of Technology level in Japan) comprised 4.4% while those who took undergraduate courses (University) but never finished a degree consisted of 12%. Only 5% of the total labor force population had completed a college degree while less than 1% had entered into a graduate school. By gender, more females entered into college and completed a degree than males (Figure 6). In other words, females have higher educational attainment than males. When disaggregated by municipality, a greater number of those with high educational attainment - post-secondary training course, college undergraduate, academic degree holder and post-graduate - reside in the cities and nearby municipalities (see Map 5). No wonder, the skilled labor force flock into the cities and adjacent municipalities because of employment to earn a living while the low educated group stays into less favorable areas which have very little opportunities for employment for skilled labor (except agriculture).

Given these socio-economic characteristics of the population together with the household characteristics of a sample population from income/expenditure survey, local poverty incidence was estimated at the city/municipal level. As a result, the spatial pattern of poverty incidence is almost similar to the previous pattern of age dependency and educational characteristics.

Map 6 presents the spatial pattern of poverty incidence in the study area. Poverty incidence is relatively low (below 35% to 40%) in cities (Naga, Legaspi and Iriga) and their adjacent municipalities. As such, these areas are usually characterized by high percentage of skilled labor force as suggested by high educational achievement and relatively low dependency ratio. Except for a few more municipalities within their periphery, poverty is worse in other municipalities with a poverty incidence ranging from 40% to 55%. These are distributed across the two provinces in different locations with no specific spatial pattern. Furthermore, poverty is extremely worst in northeastern section, specifically in Caramoan Peninsula, in the northwestern part a.k.a. the Ragay Coast, in most of the western coastline municipalities and in the isolated island municipality of Rapu-rapu. These areas have poverty incidence from 55% to as high as above 60%.

Likewise, the disparity in the incidence of poverty across the provinces is abysmal (Figure 7). Lowest poverty incidence which would represent the most affluent area is Naga City wherein 18% of its population is estimated to be living below the poverty threshold whereas the poorest municipality, Rapu-rapu Island, had an incidence of 69%. On the average, most municipalities exhibit a poverty incidence of 50% more or less, but still it is above the national average of 40% in CY 2000. In other words, the two provinces really suffer from severe poverty; moreover, its pattern is spatially heterogeneous as shown by extreme disparities in poverty incidence across space.

The total poor population in the study site accounts to approximately 1.25 million or 47% of the total population, when population of every locality is multiplied by their respective poverty incidence (Figure 8). This figure is alarming, indeed.

Furthermore, the incidence of poverty exhibits an inverse spatial pattern if compared with population density (Map 7). Areas with high poverty incidence have low population density - the Caramoan Peninsula in the northeast, municipalities in the Ragay Coast located in the northwest, the island of Rapu-rapu and some areas in south Albay, namely, the Municipality of Jovellar and Manito, all of which have less than 200 persons per sq. km.

On the contrary, the two major cities – Legaspi and Naga – and its small adjacent municipality of Camaligan, which have relatively lower incidence of poverty, posted the highest population density of more than 1,000 persons per sq. km. Some better-off municipalities surrounding these cities also have relatively higher density (400 to 1,000 persons per sq. km.) as compared to those far from these cities. This pattern may suggests that there are more poor people living in affluent areas i.e., with low poverty incidence, because of high concentration of inhabitants than in poorest areas which are less populated.

However, this is not true. As a matter of fact, the number of poor people in poorest areas (with a poverty incidence of 55% and above) far exceeds the poor population in areas with low poverty incidence (below 35%) (see Figure 9). That is to say, poor people are sparsely distributed in the poorest areas of the region while they are densely concentrated in key cities and their periphery (see Figure 11 and 12 for landscape of poverty in the city and countryside).

Meanwhile, a closer look at the family income structure reveals that low income groups are those families that depend on wages and salaries and entrepreneurial activities related to agriculture as their major source of income (see Figure 10). These include crop farming, gardening, livestock and poultry raising, fishing, forestry and hunting, among others. On the average, they earn around Php 20,000 to Php 50,000 per year. Since the average family size in Bicol Region is about five (5) members per family and poverty threshold is set at Php 11,525 per person, a family usually needs around Php 60,000 per year to be able to escape from poverty.

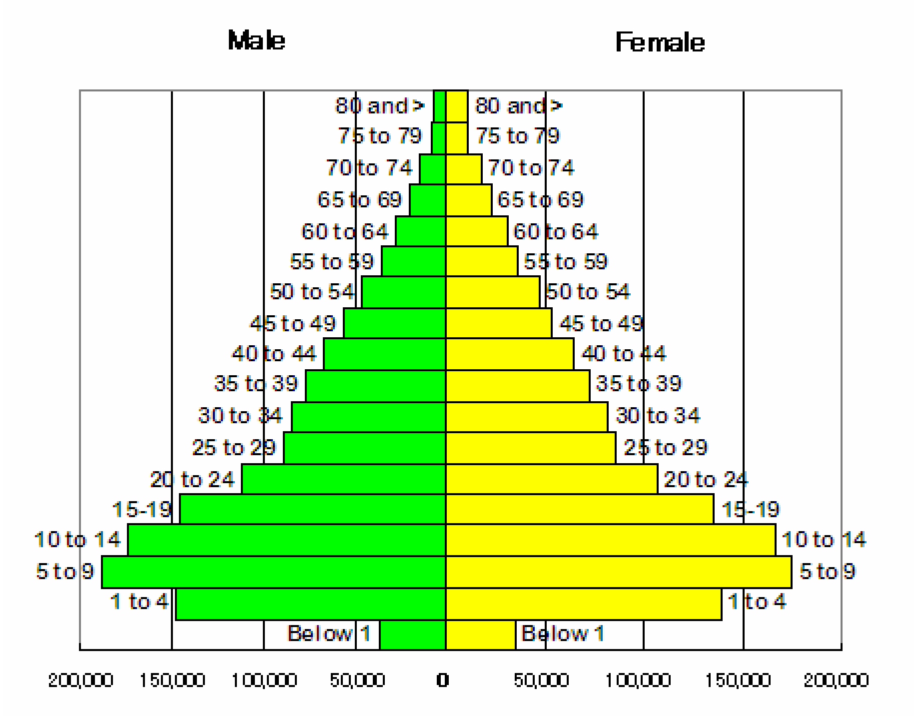
On the other hand, most families that depend on wages and salaries from non-agricultural related activities earn higher income – from Php 60,000 to more than Php 250,000 per annum. These comprise of regular salaries from professional employment, earnings from wholesale and retail activities, manufacturing, social services, transportation and communication, mining, quarrying and constructions, as well as rents from non-agricultural lands, buildings and spaces. This finding may suggest that engaging in agriculture may not be a profitable venture in the region; hence, it could be one of the possible causes of poverty. As such, according to the poverty assessment conducted by the World Bank (2001), poverty is highest in the agriculture sector.

Despite so, the agricultural sector is the biggest source of employment in the region. In CY 2001, a total of 875,000 million persons were engaged in agriculture, mostly dominated by males (see Table 8). The services sector, on the other hand, serves as the second biggest employer with 749,000 workers, more than half of whom are females while the industry sector is the least employer with 250,000 workers who are mostly males. This would imply that the region in general is still a highly agriculture-based economy with a few large-scale industries and a range of small-scale enterprises, most of which are concentrated in key cities.

**Table 8: Employed persons by major industry in Bicol Region in CY 2001**

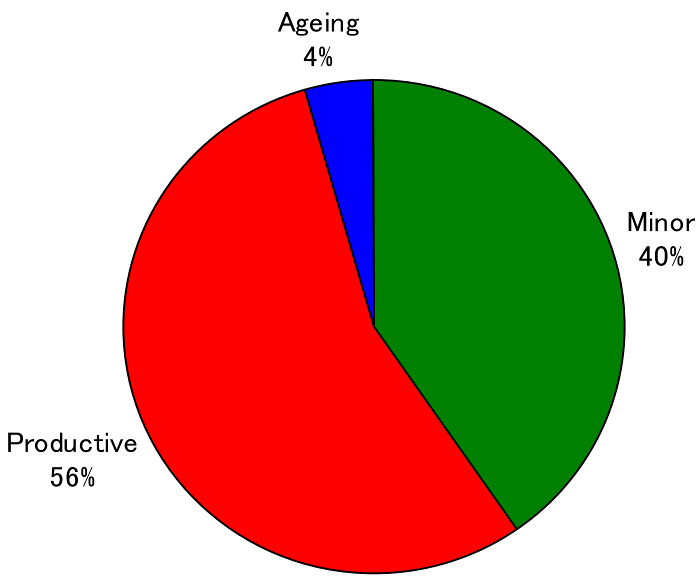
| Major Industry Group | | In thousands | | |
|---|---|---|---|---|
| | | **Male** | **Female** | **Total** |
| A | Agriculture, Hunting and Forestry | 556 | 196 | 752 |
| A | Fishing | 115 | 8 | 123 |
| I | Mining and Quarrying | 3 | 1 | 4 |
| I | Manufacturing | 57 | 76 | 133 |
| I | Electricity, Gas and Water | 5 | 1 | 6 |
| I | Construction | 105 | 1 | 107 |
| S | Wholesale and Retail Trade, Repair of Vehicles, Goods, etc. | 116 | 215 | 330 |
| S | Hotels and Restaurants | 16 | 26 | 42 |
| S | Transportation, Storage and Communication | 74 | 1 | 75 |
| S | Financial Intermediation | 2 | 6 | 9 |
| S | Real Estate, Renting and Business Activities | 13 | 5 | 18 |
| S | Public Administration & Defense, Compulsory Social Security | 49 | 28 | 77 |
| S | Education | 17 | 51 | 68 |
| S | Health and Social Work | 2 | 11 | 13 |
| S | Other Community, Social and Personal Service Activities | 27 | 32 | 58 |
| S | Private Households With Employed Persons | 4 | 56 | 59 |

*Source: Labor Force Survey, National Statistics Office*
*Note: Figures are based from the 4$^{th}$ quarter report in CY 2001; No provincial breakdown*
*Legend: A – Agriculture; I – Industry; S – Services*



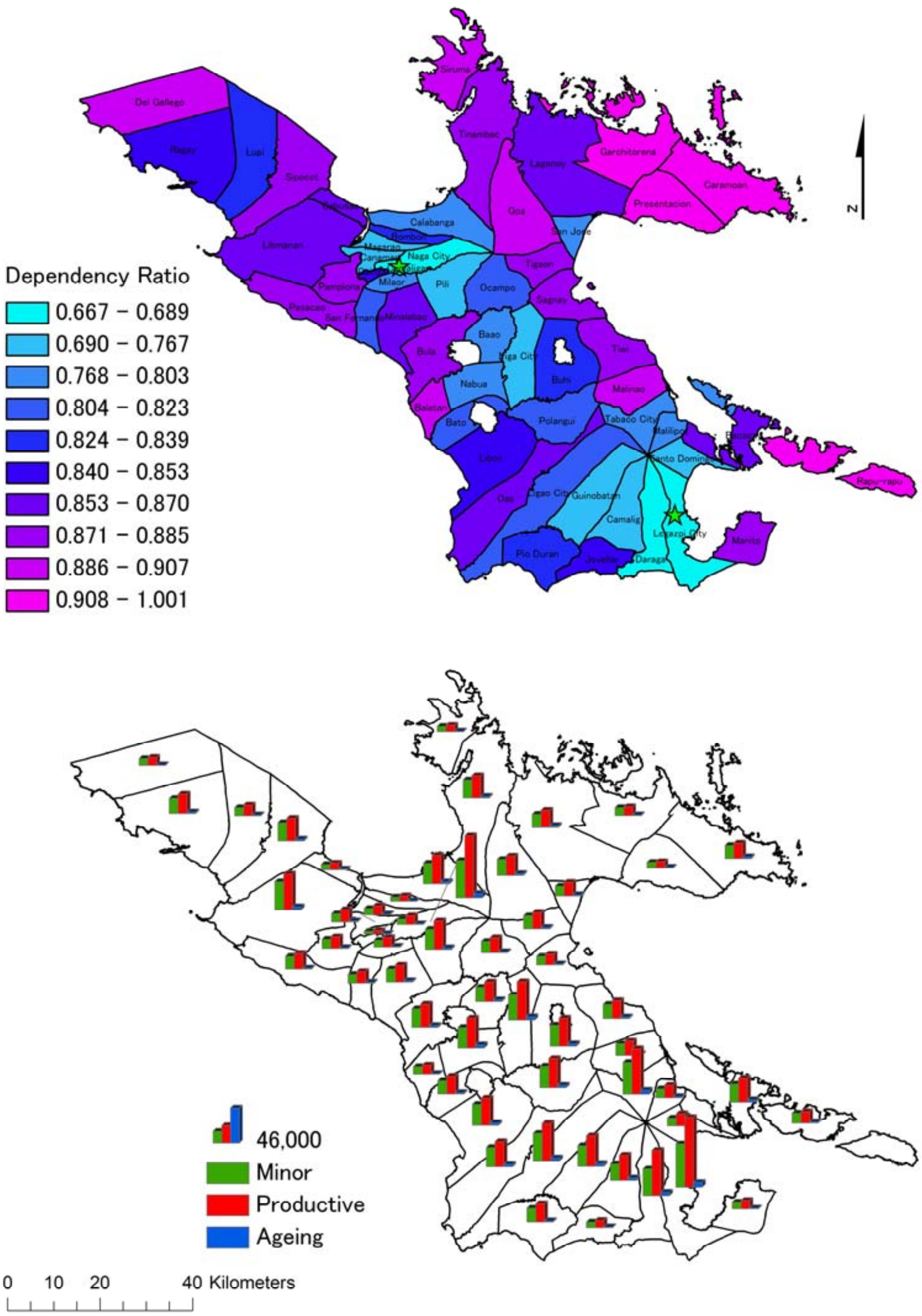

*Source: CY 2000 Census of Population*

**Figure 3: Population distribution by gender by age group in Albay and Camarines Sur provinces**

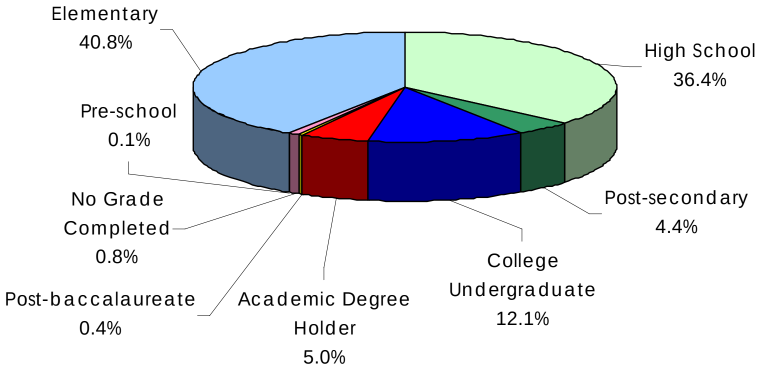



*Source: CY 2000 Census of Population*

**Figure 4: Proportion of the population by productive age group in Albay & Camarines Sur provinces**

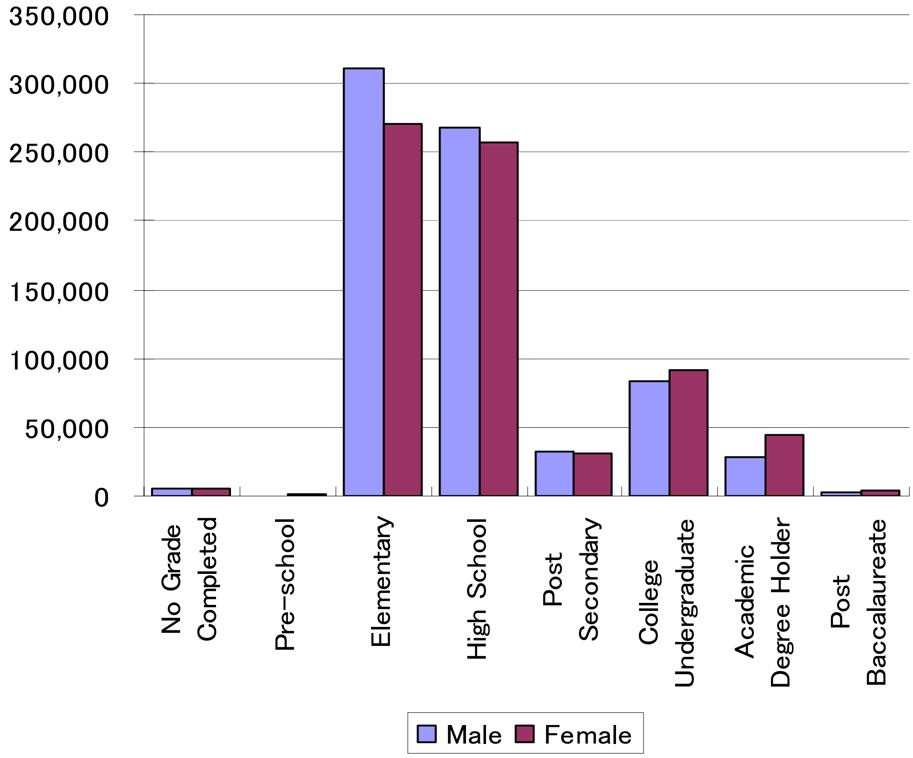



**Map 4: Spatial distribution of the population by age group and dependency ratio in CY 2000**



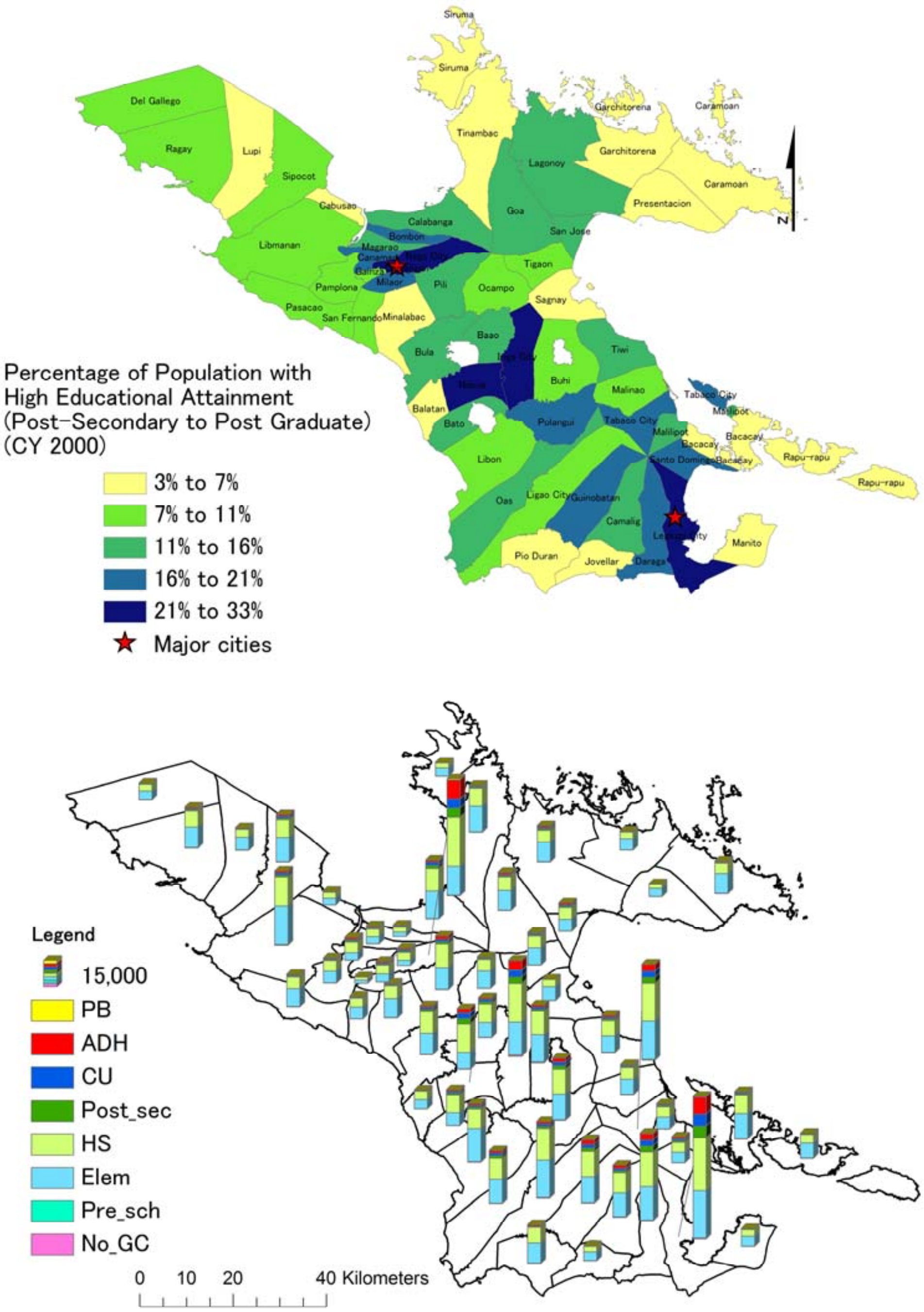

*Source: CY 2000 Census of Population*

**Figure 5: Highest educational attainment of the labor force population in Albay and Camarines Sur provinces**




*Source: CY 2000 Census of Population*

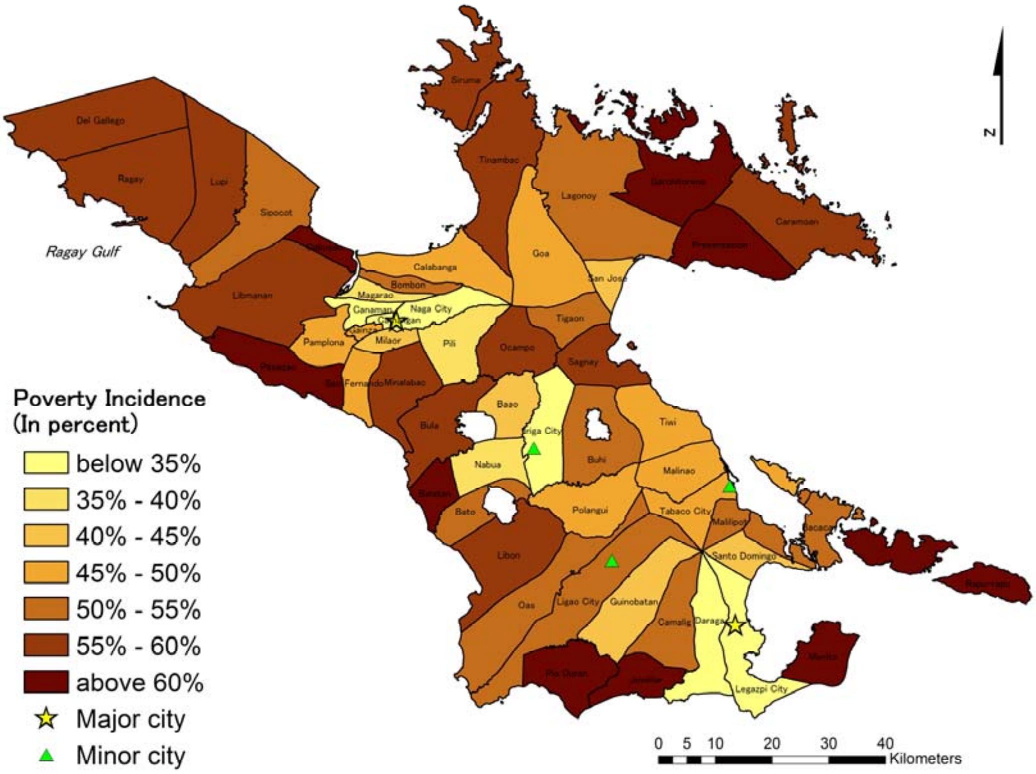
**Figure 6: Educational attainment of the labor force population by gender in Albay and Camarines Sur provinces**




**Map 5: Spatial distribution of the population by highest education attainment**

Note:

| | |
|---|---|
| PB – Post-Bacalaurette | HS – High School graduate |
| ADH – Academic degree holder | Elem – Elementary graduate |
| CU – College Undergraduate | Pre-sch - Pre-school graduate |
| Post-sec – Post Secondary graduate | No_GC - No grade completed |




**Map 6: Spatial distribution of poverty incidence**

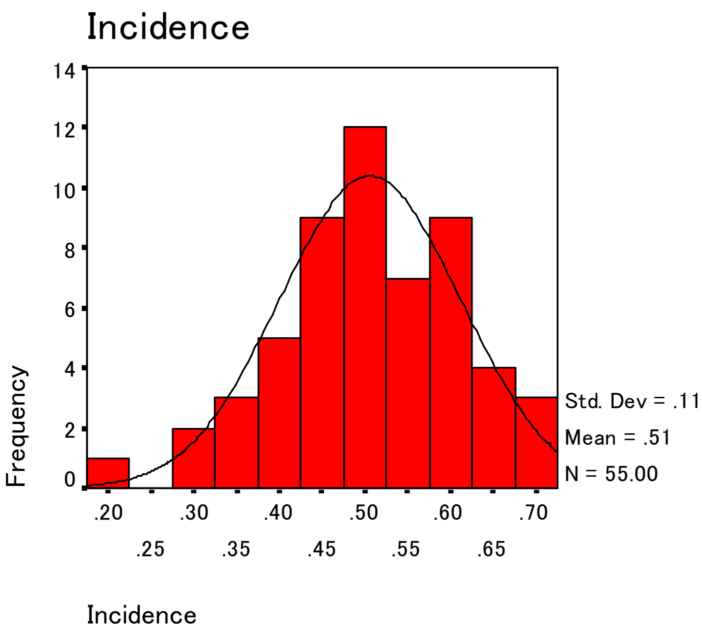



**Figure 7: Histogram of poverty incidence**

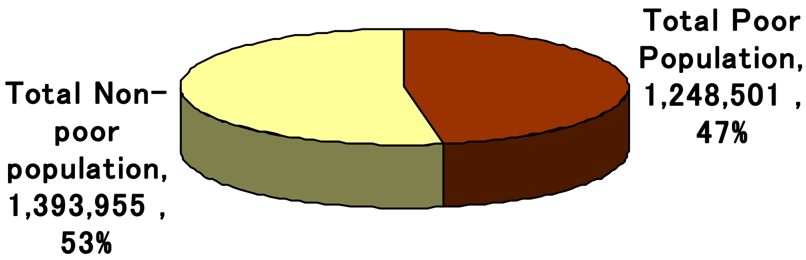
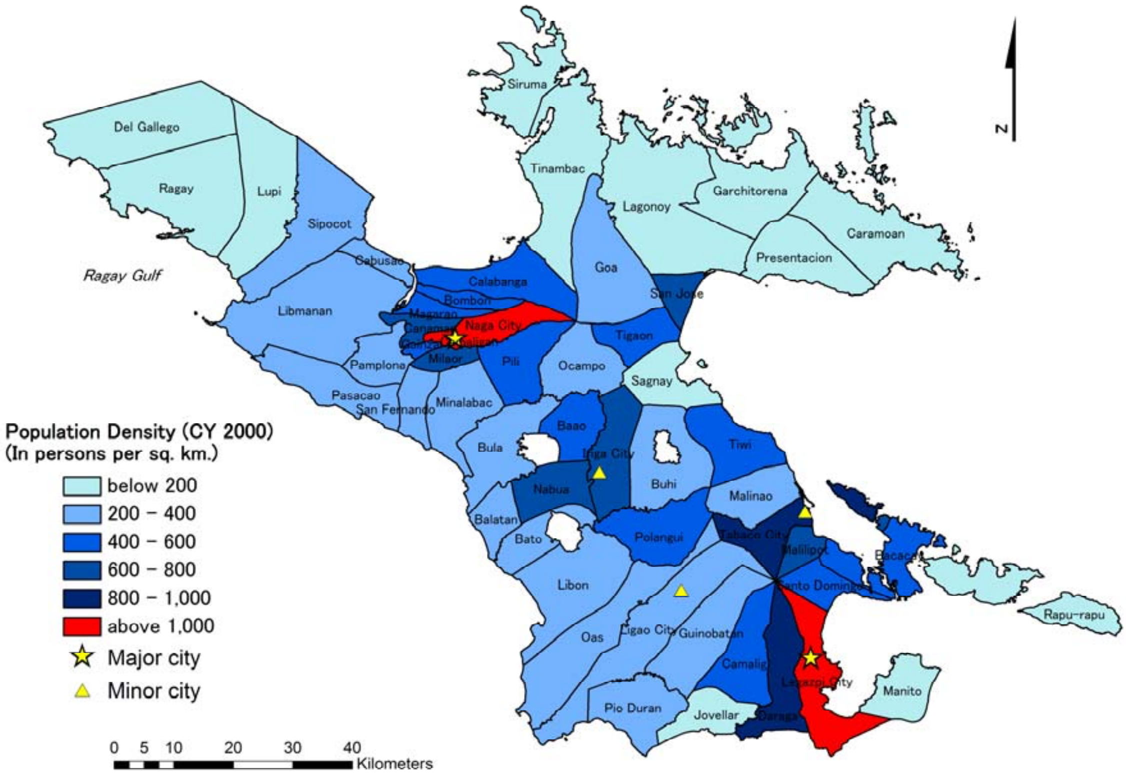



**Figure 8: Proportion of the poor population to the total population in Albay and Camarines Sur provinces**




**Map 7: Spatial distribution of population density in CY 2000**

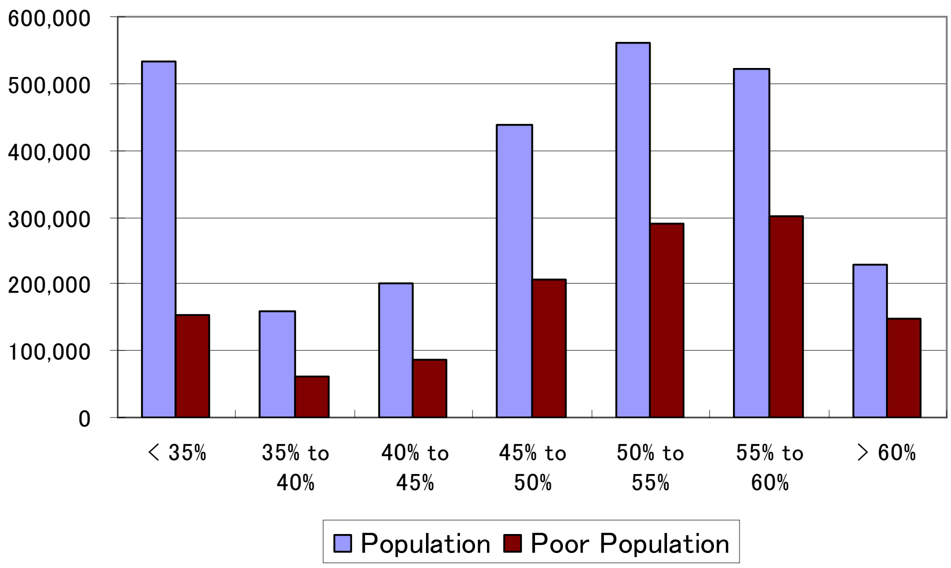
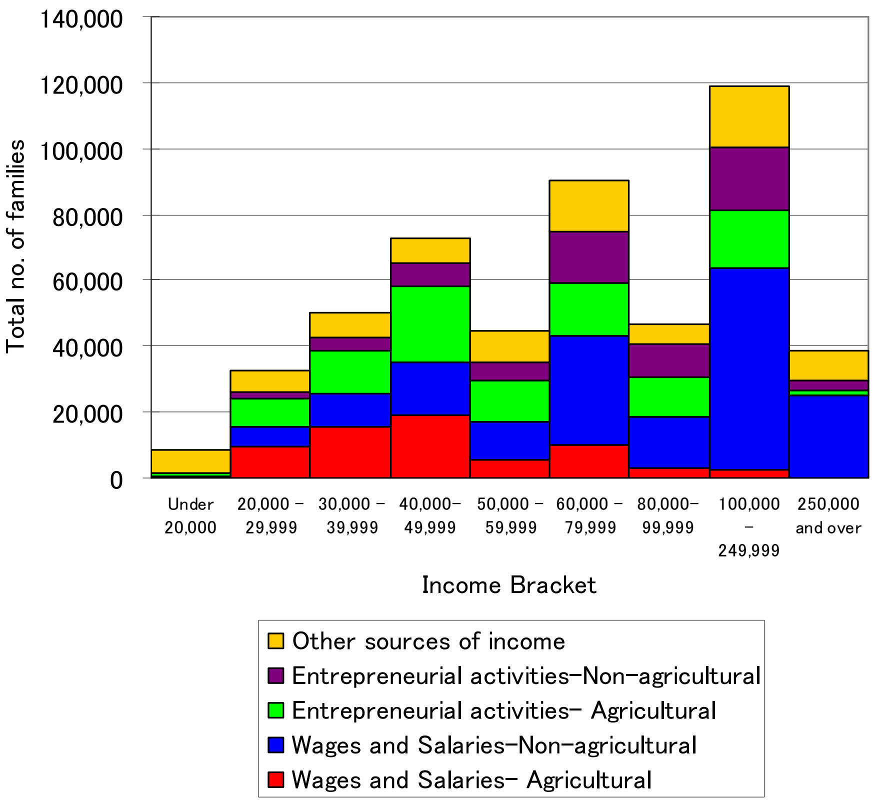



**Figure 9: Estimated number of poor population to the total population by level of poverty incidence in Albay and Camarines Sur provinces in CY 2000**




*Source: National Statistics Office, Bicol Region*

**Figure 10: Total number of families by main source of income and income class in Albay and Camarines Sur provinces in CY 2000**

**Figure 11: Shanty housing in Naga City**
(Photo taken by John Eight)

**Figure 12: Picture of poverty in the rural countryside**

Note: Wife of a poor farmer with their son living in Barangay Yabo, Sipocot, Camarines Sur
(Photo taken by Ron Nieuwsma, an American missionary)

## 5.2 Agro-climatic condition

After presenting the spatial patterns of poverty and its related characteristics, this subsection provides a discussion of the association of different variables that may have possible influence on poverty. In this particular subsection, agro-climatic condition variables i.e., elevation, slope, soil, rainfall and access to river, are presented separately to see their correlation with poverty.

### 5.2.1 Elevation

Elevation in the study site varies from as low as 0 meters to as high as 2,500 meters above sea level (see Map 8). The highest elevation is registered at the peak of Mayon Volcano. From its peak, elevation gradually decreases at the Bicol valley and reach its lowest at almost 0 meters near San Miguel Bay. Elevation varies across the two provinces but usually drops near the coastline. Generally, most highly elevated areas especially in developing countries are poorer than low lying lands because they possess economic and agricultural limitations.

By comparing it with poverty incidence, most of the highly elevated areas in the northwestern section of the study area, specifically, Caramoan Peninsula and municipalities along Ragay Coast have relatively higher incidence of poverty. This seems to suggest that elevation may have a possible effect on the level of poverty of localities. But when its mean value by city/municipality was computed using zonal analysis, results showed that mean elevation ranges from almost 0 meters in municipalities located in the Bicol plain to as high as 400 meters in Tiwi, Albay where its border cuts across the peak of Mayon Volcano (Figure 13). Subsequently, when correlated with poverty incidence, it generated a positive value of 0.106 but which is not statistically significant (see Appendix 1). This result suggests that there seems to be no significant relationship between elevation and poverty.

### 5.2.2 Slope

The slope map of the region is shown in Map 9 derived from SRTM imagery. The map clearly shows the central plain as well as small coastal plains of the region in the northeastern and eastern coast. Similar to elevation, most of the high sloping areas found in Caramoan Peninsula, Ragay Coast, including municipalities along the western and eastern section of the study area as well as the island of Rapu-rapu exhibit relatively high incidence of poverty. On the other hand, localities situated in the central plain have relatively lower incidence.

When aggregated by slope gradient and correlated with poverty incidence, areas covered by land with a slope greater than 8% usually displays high incidence of poverty (Figure 15) while those with slope 0 to 8% normally exhibit low incidence (Figure 14). The correlation coefficient is also statistically significant with a value of 0.530. This may suggest that slope has a relationship with poverty and it may have a possible influence on its persistence. Higly sloping lands would most likely not suitable for agriculture and economic activities, hence these areas are poorer than those with more flat and alluvial lands which are productive to agriculture.

### 5.2.3 Soil

In terms of soil characteristics, the study site comprises a variety of soil texture types ranging from clayey to gravelley (Map 10). Clay and clay loam is the dominant soil type. When soils were classified according to constraints, clay, silty clay, clay loam, sandy clay loam, loam, and silt loam were considered to be soils with no limitations to agriculture and suitable for farming because these soils have fine, moderately fine and medium texture (Fisher *et al.*, 2000 and University of Arizona, 1998). The rest possess moderate to severe constraints. On this regard, most probably, soil with severe constraints may have an effect on the condition of poverty due to the limitations imposed on the productivity of the land. This would most likely restrict the people to earn income from agricultural activities, thereby making them impoverished.

Again by simply looking at the map, the poorest section of Caramoan Peninsula possesses a geographical disadvantage in terms of its soil characteristics – mountain soil, complex soil and sandy loam. Similarly, the central part of Albay has constraint to agriculture because it is covered by gravelly and fine sandy loam encircling around Mayon Volcano. However, when the percentage of soil based on the absence or presence of constraint was computed and subsequently correlated with poverty incidence, results shows that there seems to be a very complex pattern of association (Figure 16 & 17). The graph seems to show that there is no pattern of relationship between soil characteristics and poverty. As such, correlation analysis reveals very weak association of soil and poverty, which is quite unexpected (Appendix 1).

### 5.2.4 Rainfall

The possible influence of rainfall to poverty as one of the agro-climatic variables is however undetermined. Annual rainfall of Bicol region in CY 2000 is presented in Map 11 which was derived from spatial interpolation of rainfall values recorded from 13 weather observation facilities. The generated map is almost consistent with the general climate map of the Philippines; hence, the estimated rainfall values would be fairly similar with the actual rainfall scenario.

The said map shows that the western section of the region (near the Pacific Coast) received the highest amount of rainfall annually with more than 4,500 millimeter. The eastern part, specifically Masbate Province, received less rainfall amount starting from 3,000 millimeters. Such distribution reflects disparities in rainfall due to the influence of typhoons from the Pacific Ocean bringing heavy downpour in this area.

However, compared to the rest of the Bicol region, the two provinces of Albay and Camarines Sur, received relatively higher amount of rainfall which varied from 3,750 mm. to more than 4,500 mm. during the said year. The Bicol valley received a quite high amount of rainfall ranging from 4,250 mm to 4,500 mm. When computed by municipality and compared with poverty incidence, the influence of rainfall to poverty varies widely (Figure 18). Municipalities in the western coast have less amount of rainfall but high incidence of poverty. On the contrary, municipalities in the northeastern part with higher rainfall amount also suffer from high poverty incidence. Correlation analysis also shows that the relationship between rainfall and poverty is not significant (Appendix 1)

### 5.2.5 Access to River

Last but not the least among the possible determinant of poverty is access to river. More often than not, rivers serve as a source of water for irrigation of farmlands in the Philippines. Rivers also serve as source for fishing livelihood. In rare cases, rivers could serve as a means of transportation in the country.

As described in Chapter 3, a network of rivers, streams and creeks traversed across several municipalities within the Bicol plain as well as in northeastern part of the region. As expected, when river density was computed, density is higher in the central plain with large tracks of agricultural farmlands (see Map 12). When its mean value was computed by municipality and correlated with poverty incidence, mean river density seems to show an inverse pattern (see Figure 19). Municipalities with relatively higher mean river density generally exhibit low poverty rate and vice versa. Correlation analysis also shows that there is a significant relationship between river access and poverty. Its negative correlation coefficient (Appendix 1) implies that localities with more access to river resources have low poverty incidence. These areas are relatively well off, probably because they have a geographical advantage since river is generally source of water for irrigation and fishing livelihood.

## 5.3 Access and Proximity

Aside from the natural resource endowment of the region, access to existing road infrastructure and proximity to major markets and economic centers may possibly play major a role in understanding the spatial variations of poverty condition in the study area. This is further discussed in the succeeding subsection of this chapter.

### 5.3.1 Access to Road Infrastructure

In this analysis, road density was considered as the major indicator of accessibility of every municipality. Map 13 shows the road density map of the study site. If compared with the map of incidence of poverty, highest road density is concentrated in cities of Naga, Legaspi and Iriga and their peripheries, which are characterized by relatively low poverty rate. On the hand, low density of roads are found mostly in areas with high incidence of poverty - the Caramoan Peninsula, Ragay Coast, as well as in the southern portion of Albay and in Rapu-rapu Island.

When mean road density is computed by municipality and correlated with poverty incidence, it portrays a strong inverse effect on poverty (Figure 20) and is statistically significant with a negative coefficient of -0.746 (see Appendix 1). This value indicates that there is a very strong association between road density and poverty incidence. Localities with low road density, hence low road access have high incidence of poverty. On the reverse side, areas with high road density have low poverty incidence. This pattern further suggests the important role of road infrastructure in understanding the state of poverty in the study site. It is most likely that access to road facilitates the exchange of good and services to different parts of the region. Roads link people and communities together and create an opportunity for economic growth and development.

### 5.3.2 Proximity to Major Markets

Every locality is related with one another in different ways. In this analysis, the relationship in terms of proximity of town centers to major markets is explored. In the case study area, Naga and Legaspi serve as the two major markets of the region where economic activities are concentrated. Naga City which is located on the central plain is as a highly urbanized city in Camarines Sur whereas Legaspi City found at the southwestern part functions as the provincial capital of Albay and the regional center of Bicol. Both cities serve as the center of commerce and trade. To explore the relationship between the major markets and the rest of the localities, distance was computed from each town center to their closest major city.

Map 14 shows the network of towns and their nearest major cities clustered into two groups – Naga and Legaspi. When distance from each town center was calculated and correlated with poverty incidence, the result shows (Figure 21) a direct relationship. Correlation coefficient generated a positive value of 0.582 and is statistically significant. Thus, there is a significant relationship that exists between distance to major markets as represented by major cities and poverty as indicated by its incidence. As distance of town center farther away from the major cities, poverty incidence usually increases. The farthest and poorest municipalities are located more than 60 kilometers away from these major cities. Likewise, these municipalities are located in the Caramoan Peninsula, in the northeastern part of Camarines Sur and some municipalities in southern Albay. On the other hand, the island of Rapu-rapu, while it is approximately 50 kilometers away from Legaspi City, is extremely far if difficulty in transportation is accounted, which is only possible by small boats. Again, its geographical location and isolated position may certainly be one of the major factors of its very high incidence of poverty.

## 5.4 Influence of Government Programs and Policies

Whereas the first two groups of variables previously discussed correspond to the physical and geographical characteristics of the region, this next group of factors deals with the influence of government programs and policies which is also deemed important. Herein, two aspects were considered: the land distribution program under the Comprehensive Agrarian Reform Program (CARP) and the fiscal decentralization policy under the Local Government Code of 1991, both of which are expected to contributed to poverty reduction. These two are discussed in the succeeding part of this subsection.

### 5.4.1 Land Distribution

In a country that is predominantly agriculture like the Philippines, inequalities in land ownership have been recognized to be a major contributor to widespread poverty. Empirical evidence shows that Philippine poverty remains largely rural and that agrarian problems lie at the root of that poverty. Due to the lack or absence of alternative sources of livelihood, majority of rural people still rely directly or indirectly on agriculture as their major subsistence. In most instances, the only productive asset that they can rely is land. Thus, since the 1960's the government implemented a series of asset distribution measures, the latest of which is the Comprehensive Agrarian Reform Program (CARP) of 1987. Under this program, all lands suitable for agriculture should be distributed to landless farmers and tenant workers in order to uplift them from the bondage of poverty. Almost every cities and municipalities throughout the Philippines is covered by CARP. Generally, it is assumed that the higher the percentage of accomplishment in land distribution in every municipality, the greater its contribution to alleviate poverty. Thus, agrarian reform could possibly lower the incidence of poverty.

Taking the case of the two selected provinces, CARP covers 187,000 hectares of agricultural lands identified for distribution. Since its inception in 1987, the government has distributed around 107,000 hectares of lands accounting to about 57% (Figure 23). Yet still, around 80,000 hectares of lands remains undistributed. Map 15 shows the spatial distribution of the scope of the agrarian reform program vis-à-vis accomplishment of the government disaggregated by municipalities and overlaid with poverty incidence. The scope of agricultural lands for distribution is usually higher in most municipalities with relatively high poverty incidence. Figure 24 validates this finding. High agrarian scope is found in municipalities with 45% to above 70% poverty incidence. It ranges from 28,000 hectares to 65,000 hectares as compared to municipalities below 45% in poverty incidence. This further suggests that poorest localities are mostly agriculture-based areas.

But a closer look at the Map 15 also shows that several poor municipalities with low accomplishment in land distribution are located in Caramoan Peninsula, Ragay Coast and southern part of Albay. Meanwhile high accomplishment could also be found in most municipalities located in the Bicol plain. As such, when the rate of accomplishment was computed by municipality by dividing the scope against the total distributed lands and subsequently, the results were correlated with poverty incidence (Figure 22), it yielded a negative bivariate correlation coefficient of -0.208 (see Appendix 1). However, the correlation is not statistically significant which implies that there is a weak or even no relationship between land distribution and poverty.

### 5.4.2 Fiscal Decentralization

Lastly, fiscal policies may possibly play a crucial role in catalyzing economic growth and development and consequently, in combating poverty. On this regard, the government passed a law a.k.a. the Local Government Code of 1991 decentralizing functions of the national government to every local government unit (LGU) and providing funds thereof. This fiscal decentralization strategy intends to shift development efforts from the national center, particularly in Manila, towards the regions and the rural countryside. Every year the national government allocates certain amount of funding support to every LGU throughout the country as a share of the national wealth to support the decentralization of development activities. This funding support is called Internal Revenue Allotment (IRA) which is similar to the Local Allocation Tax of Japan. Most LGUs depend on IRA to run their respective bureaucracy and implement development projects within their domain. Hence, this aspect has been examined in this study.

A total of 2.8 Billion Pesos was allocated by the national government to all of the LGUs in the two provinces in CY 2000 alone. Three cities which have relatively low poverty incidence, namely, Naga, Legaspi and Iriga, top the list of funding support (Map 16). These three LGUs received a range of 150 to 180 Million Pesos (Figure 26) which already constitutes 18% of the total IRA for the two provinces (Figure 27). The rest of the municipalities, on the other hand, receive a meager portion, each amounting only to 10 to 50 Million Pesos at the most. As expected, when the share of every LGU is computed against the total IRA for the two provinces and correlated with poverty incidence (Figure 25), there is a strong inverse relationship as indicated by its negative correlation coefficient of -0.530 (see Appendix 1). Thus, this implies that there is an extreme disparity in IRA allocation. Well-off cities received the bigger share at the expense of poor LGUs.

## 5.5 Population Growth

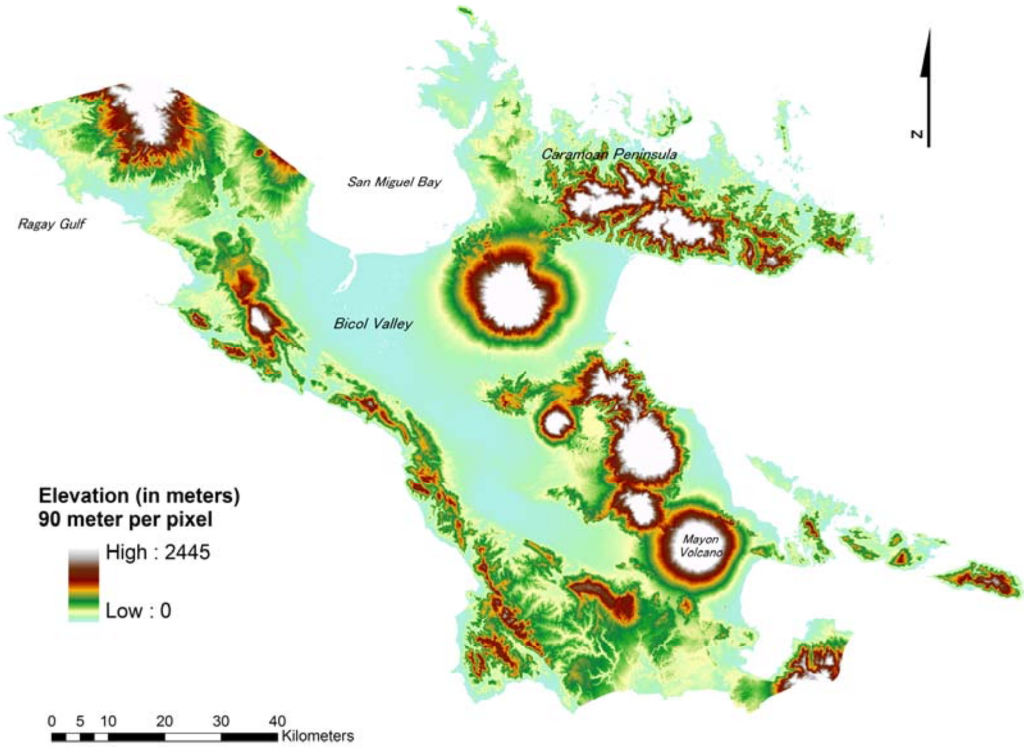
After taking a look at the effect of government programs and policies, it is also deemed important to explore the influence other related factors on the state of poverty. In this study, only population growth is considered as one of the possible factors. Generally, population growth is viewed as a deterrent to development and economic growth especially in developing economies. The ballooning population is regarded as one of the major factors contributing to the worsening of poverty condition.

Based from population statistics, Albay and Camarines Sur's population grew for the past decade from 1990 to 2000 by an average of 1.9 and 1.74, respectively (see Appendix 15). In absolute terms, the population in the study site has climbed by 400,000 from 2.2 million in 1990 to more than 2.6 million at the end of the century (see Figure 28). Population increased was evident in the two major cities of Legaspi and Naga (Figure 29).

When population growth rate by locality was mapped using GIS, Legaspi City and localities adjacent to Naga City posted a relatively higher population growth rate (greater than 2.5%) as compared to the rest of the study site (see Map 17). Surprisingly, some municipalities with higher incidence of poverty located in Caramoan Peninsula, Ragay Coast and Rapu-rapu Islands have relatively low population growth rate. Only one municipality, Siruma, in the Caramoan Peninsula has registered a high growth rate of 2.23%.

When population growth rate and poverty incidence were correlated, Figure 30 shows that there seems to be an inverse relationship between the two as shown by the downward trend of points and its negative correlation coefficient.which is statistically significant. This means that normally, the growth of the population was found to be high in better-off areas especially in key cities and their nearby municipalities while its growth is relatively low mostly in the poorest areas.

There may be other demographic as well as socio-economic factors that were not considered in this study. This may include types of employment, level of economic activities, transportation and communication flow, and many others. Although, this research attempted to include these aspects, data are not currently available and not disaggregated by cities/municipalities. Thus, this could be accounted by the errors accorded in the regression equation. The next section presents and discusses the results of the multiple regression analysis combining all of the variables mentioned above.




**Map 8: Elevation map**

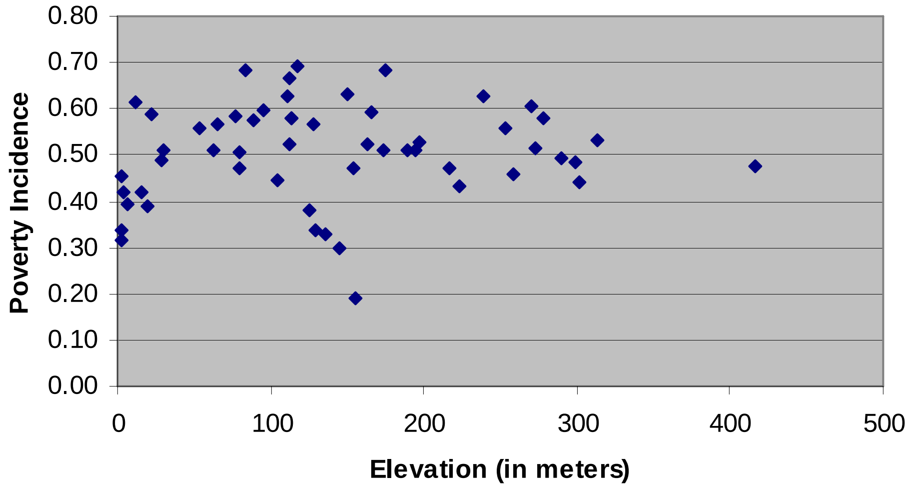
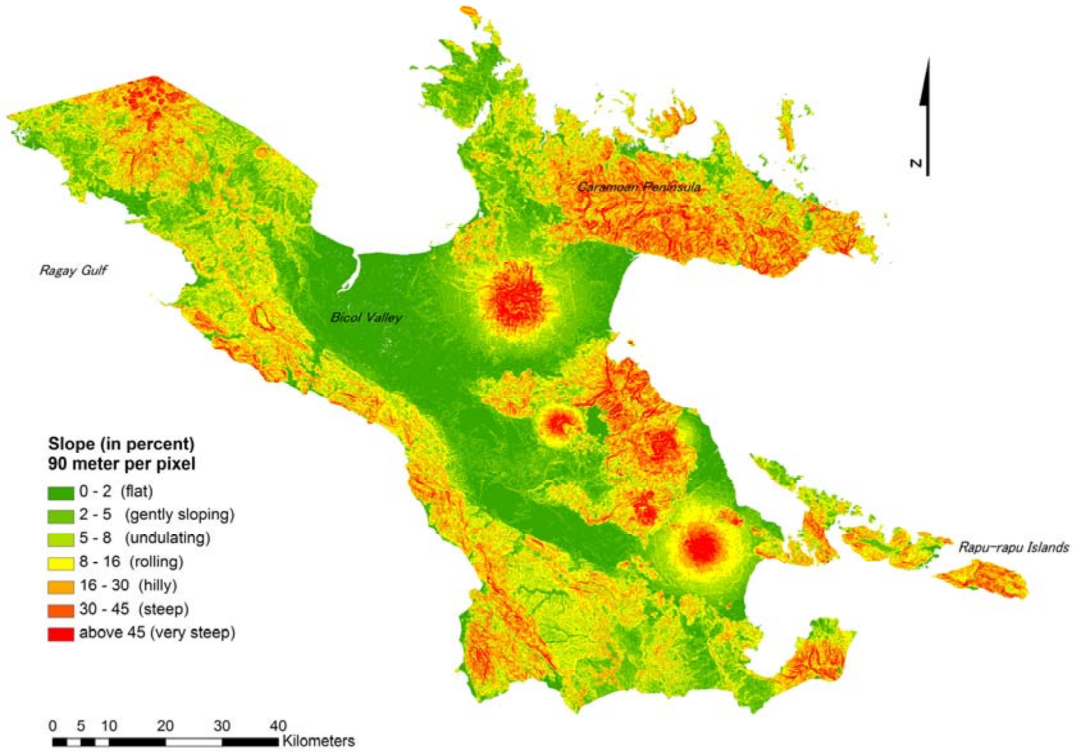



**Figure 13: Mean elevation vs. poverty incidence in the study area**




**Map 9: Slope map**

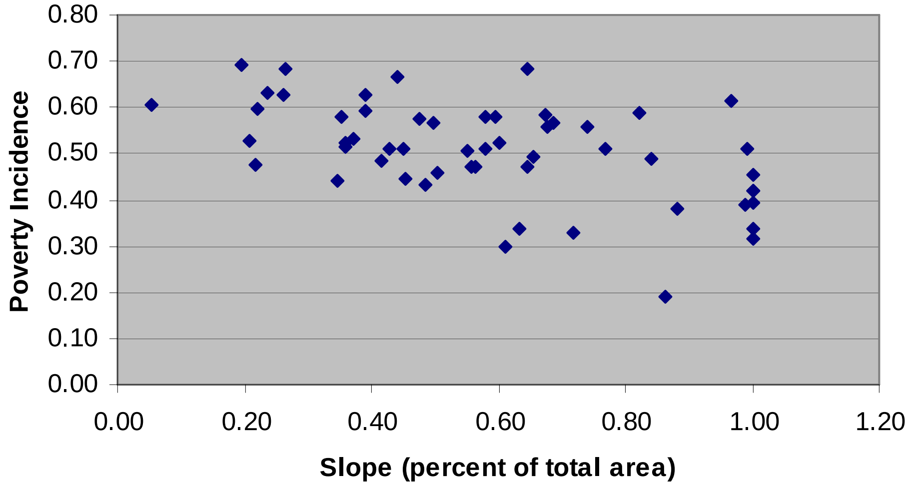



**Figure 14: Percentage of slope 0 to 8% vs. poverty incidence in the study area**

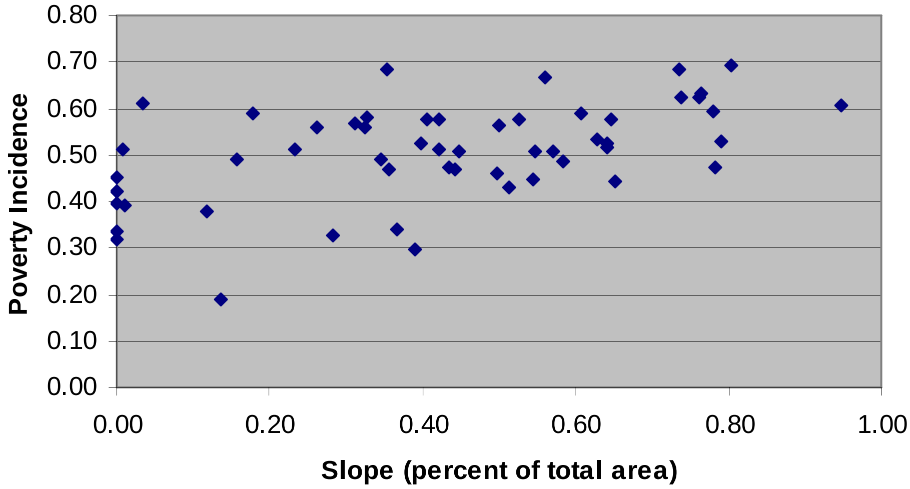
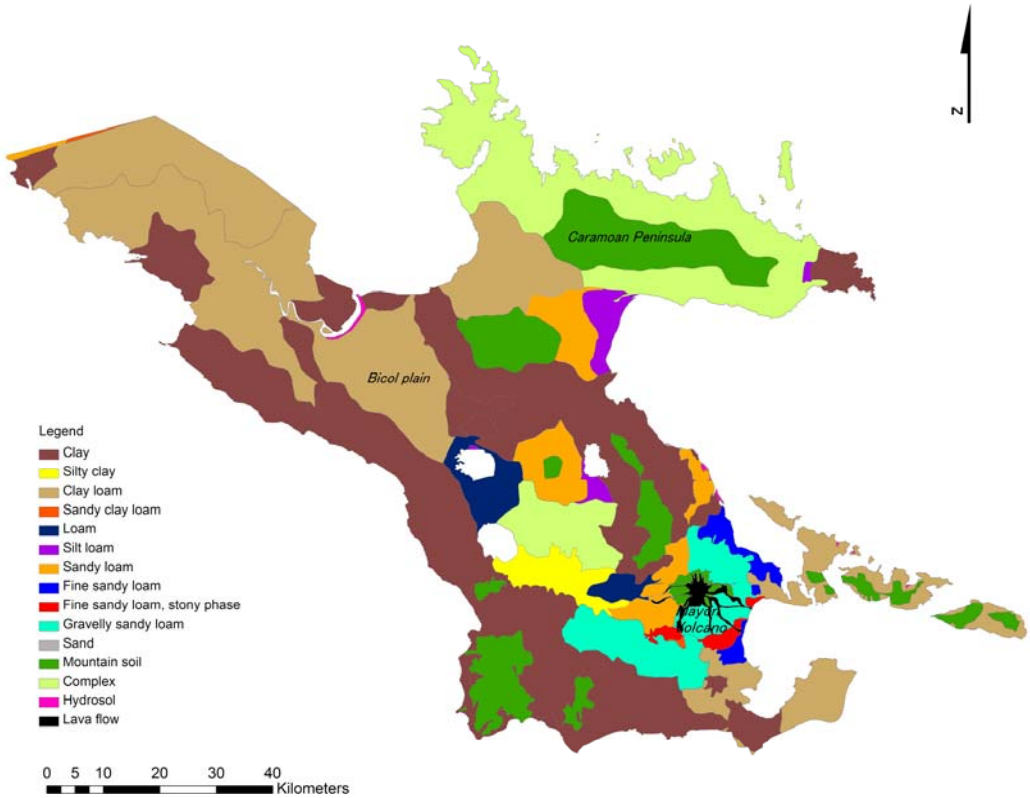



**Figure 15: Percentage of slope above 8% vs. poverty incidence in the study area**




**Map 10: Soil map**

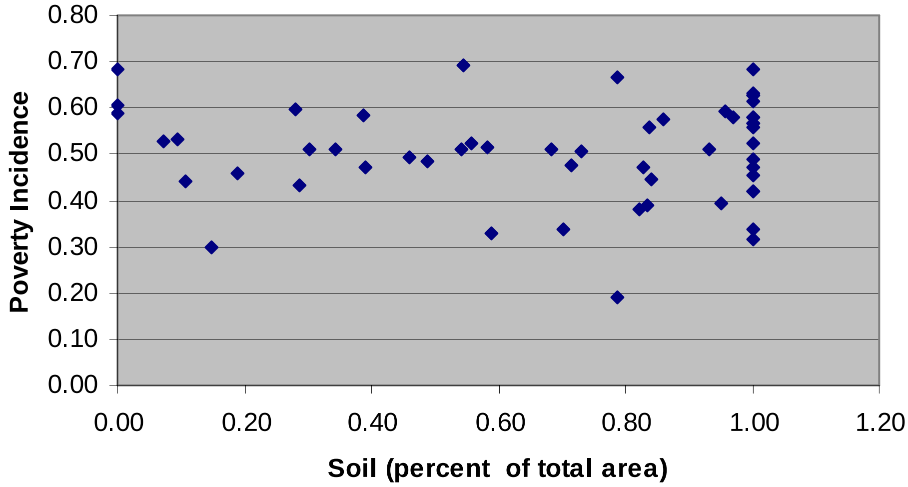



**Figure 16: Percentage of soil without constraint vs. poverty incidence in the study area**

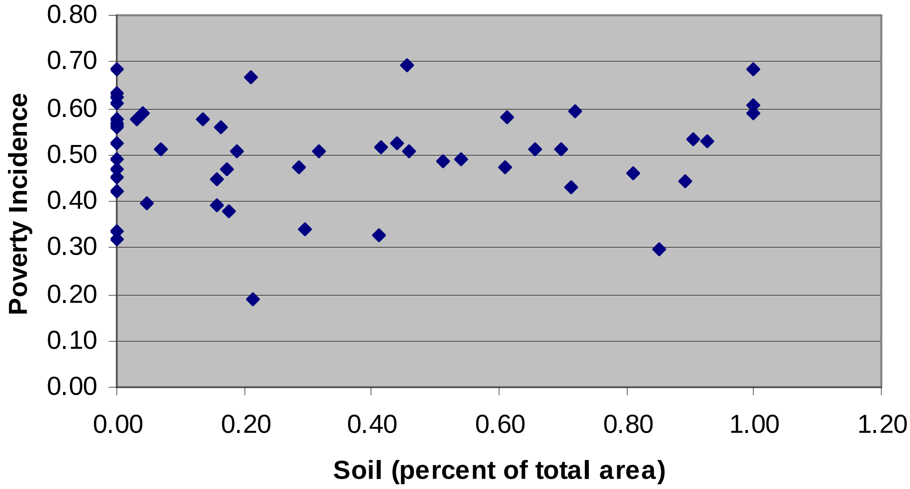
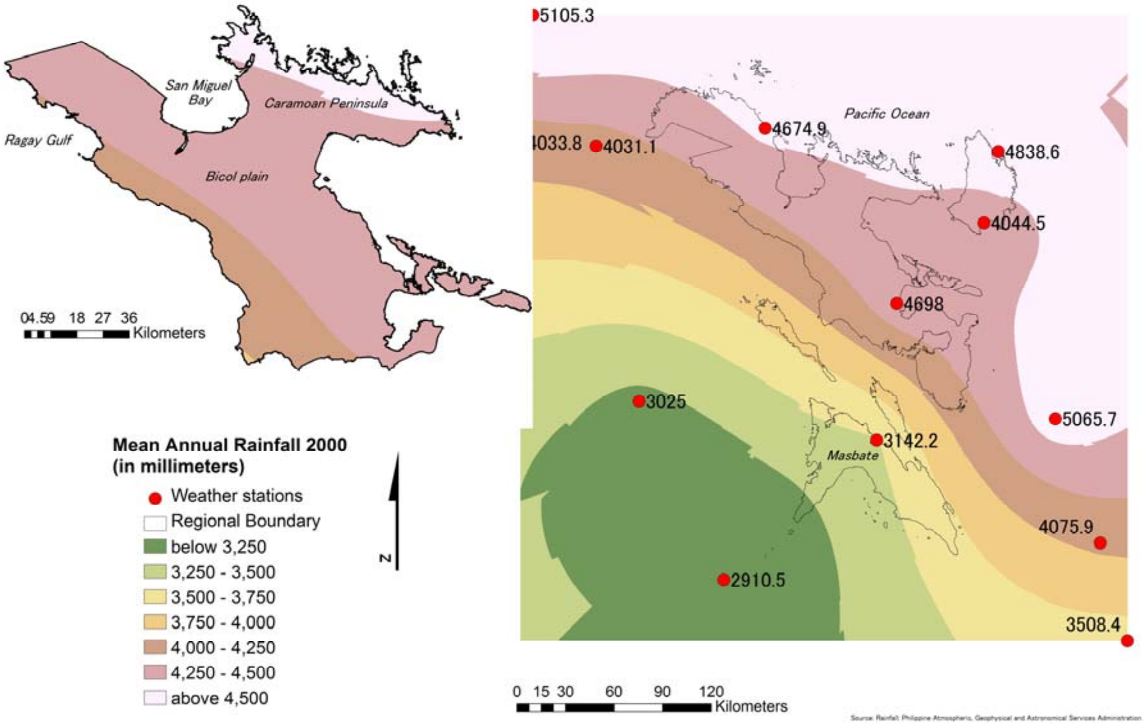



**Figure 17: Percentage of soil with constraint vs. poverty incidence in the study area**




Map 11: Rainfall map

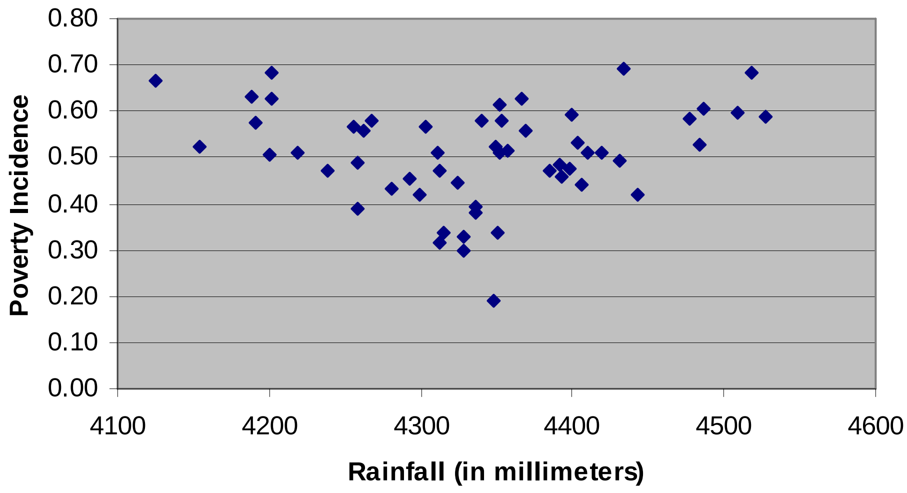
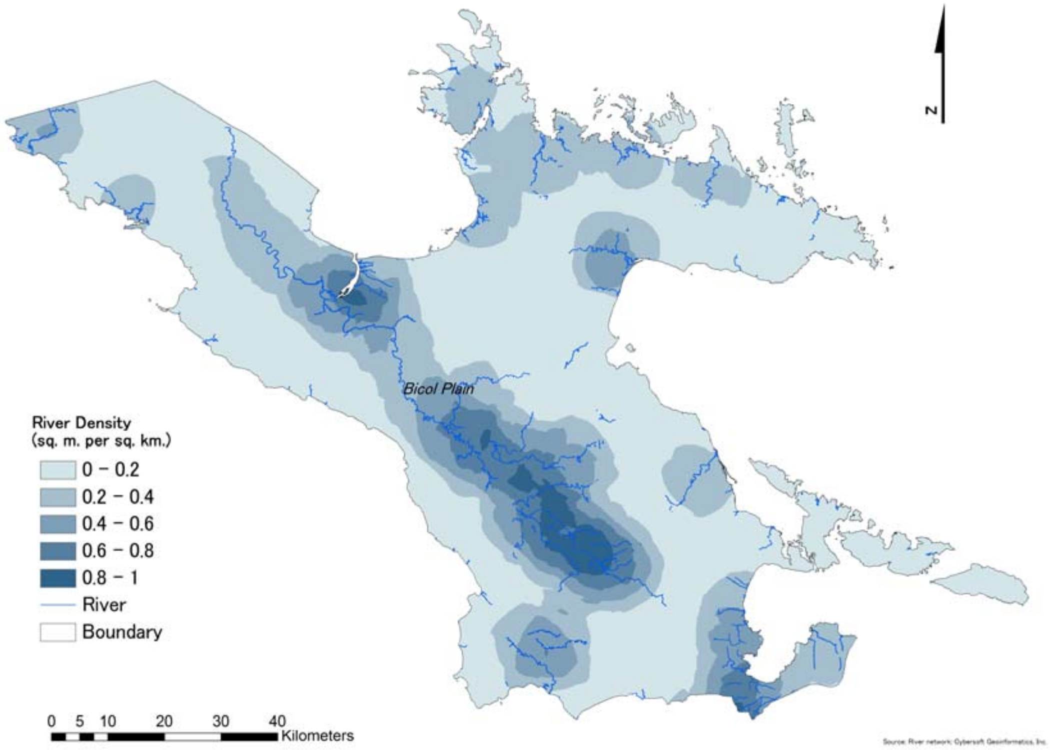



**Figure 18: Mean annual rainfall vs. poverty incidence in the study area**




**Map 12: River density map**

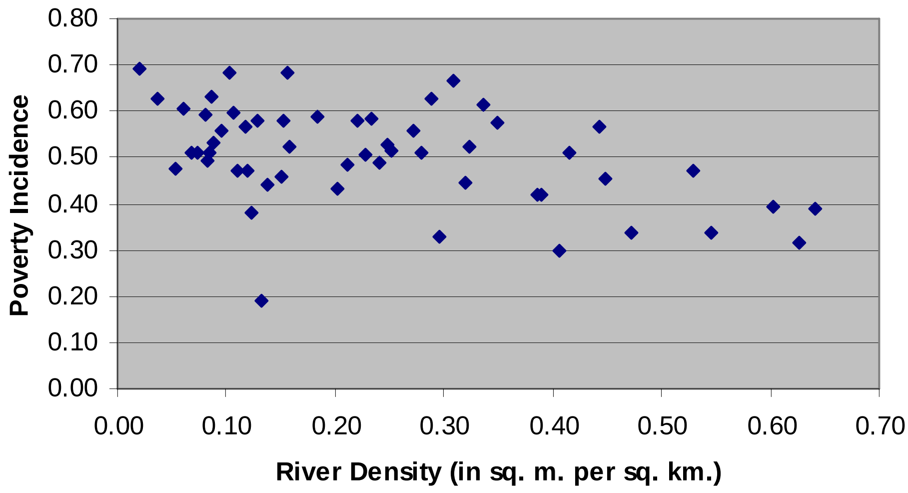
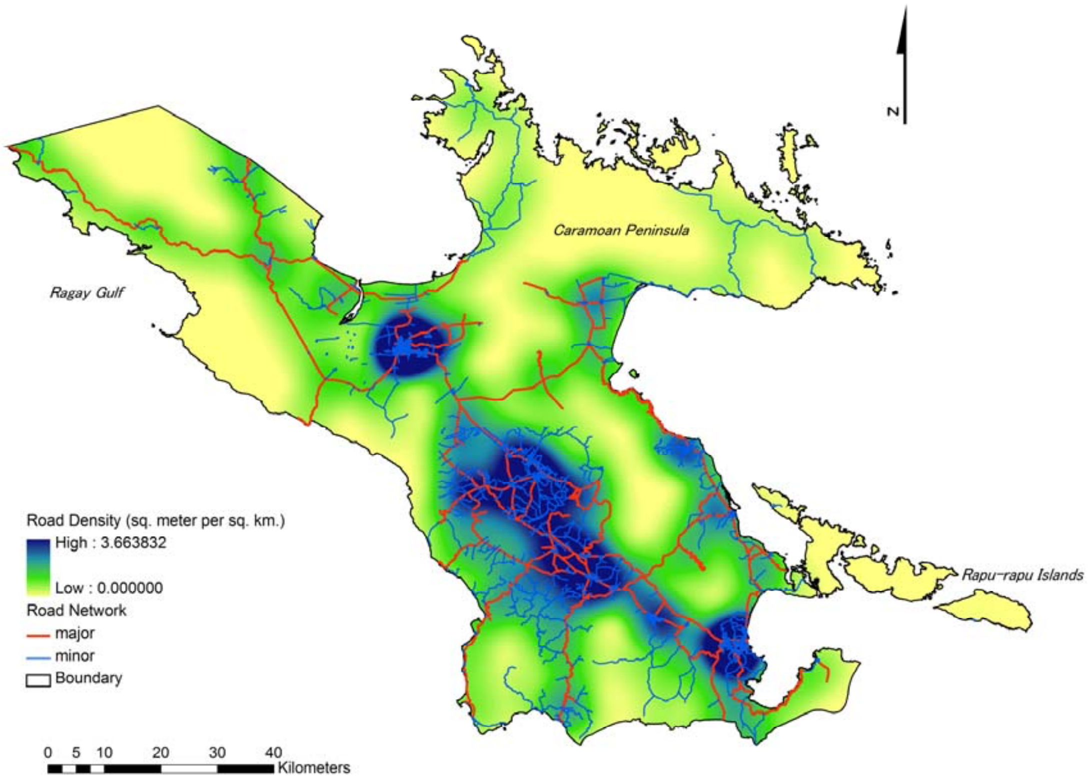



**Figure 19: Mean river density vs. poverty incidence in the study area**




**Map 13: Road density map**

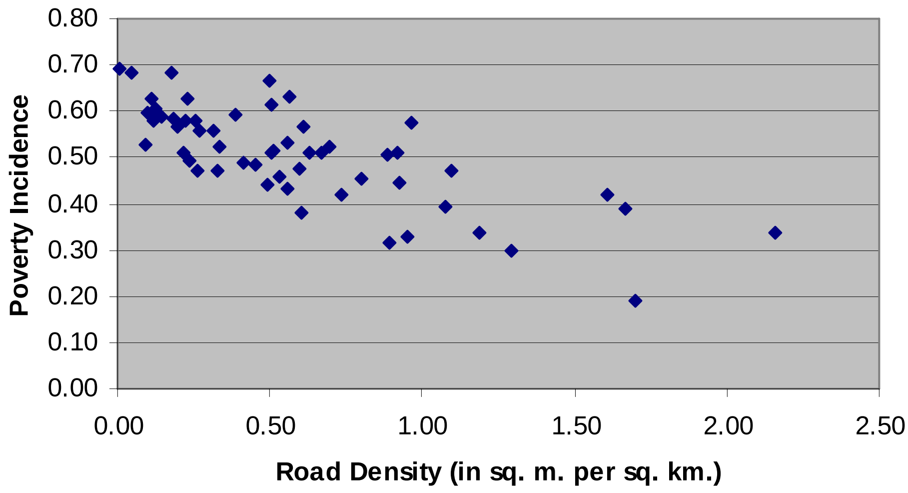
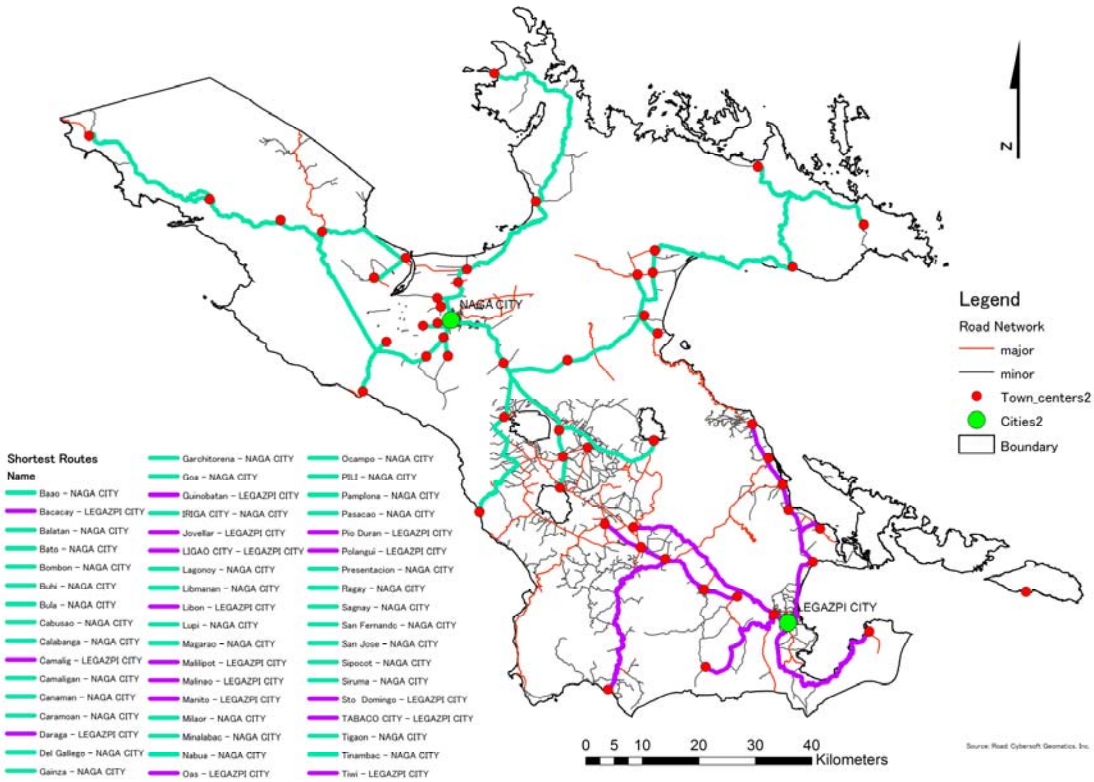



**Figure 20: Mean road density vs. poverty incidence in the study area**




**Map 14: Shortest distance to major cities**

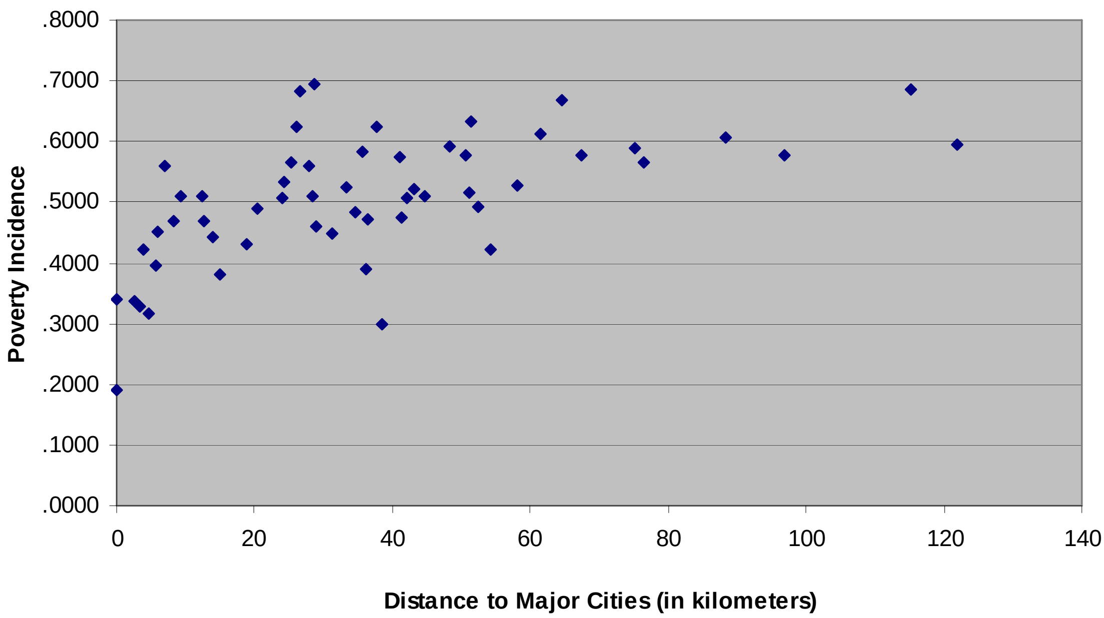
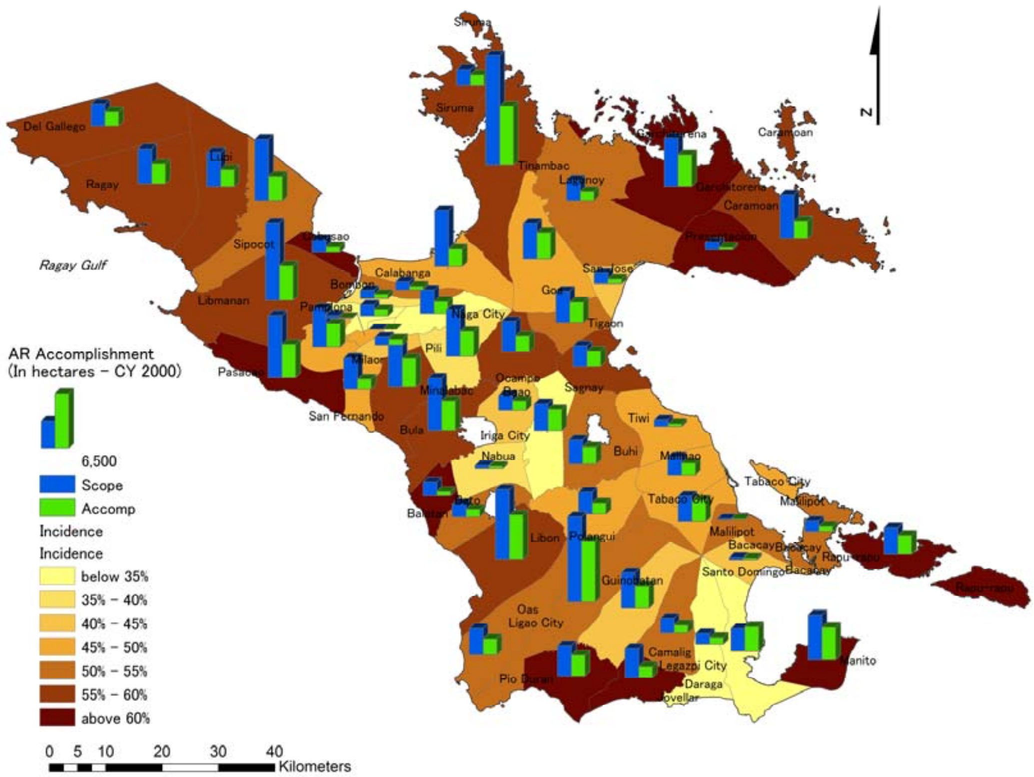



**Figure 21: Distance to major cities vs. poverty incidence in the study area**




**Map 15: Spatial distribution of land reform coverage, accomplishment and poverty incidence**

Note: Scope – Total agricultural lands targeted for distribution
Accomp – Total lands distributed as of CY 2000

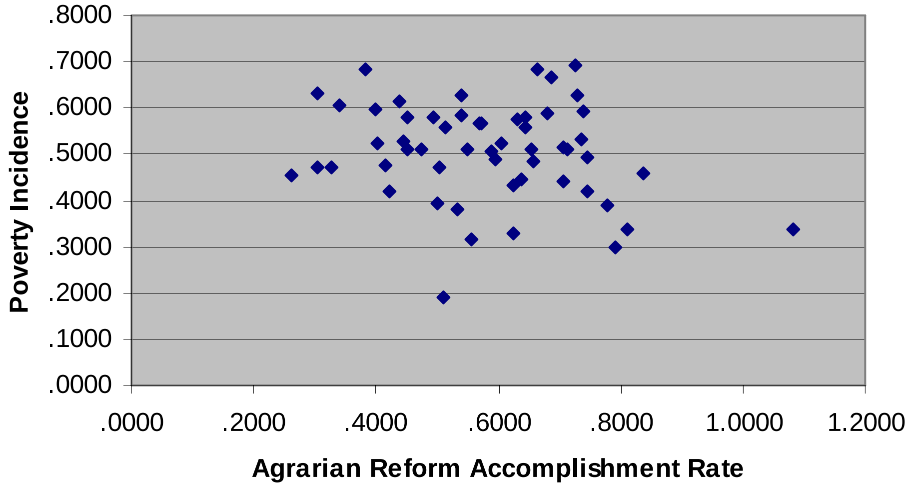



**Figure 22: Agrarian reform accomplishment rate vs. poverty incidence in the study area**

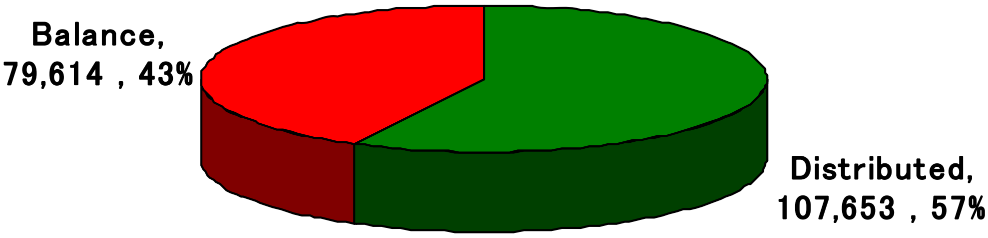



**Figure 23: Proportion of land distribution under the Comprehensive Agrarian Reform Program in Albay and Camarines Sur Provinces as of CY 2000**

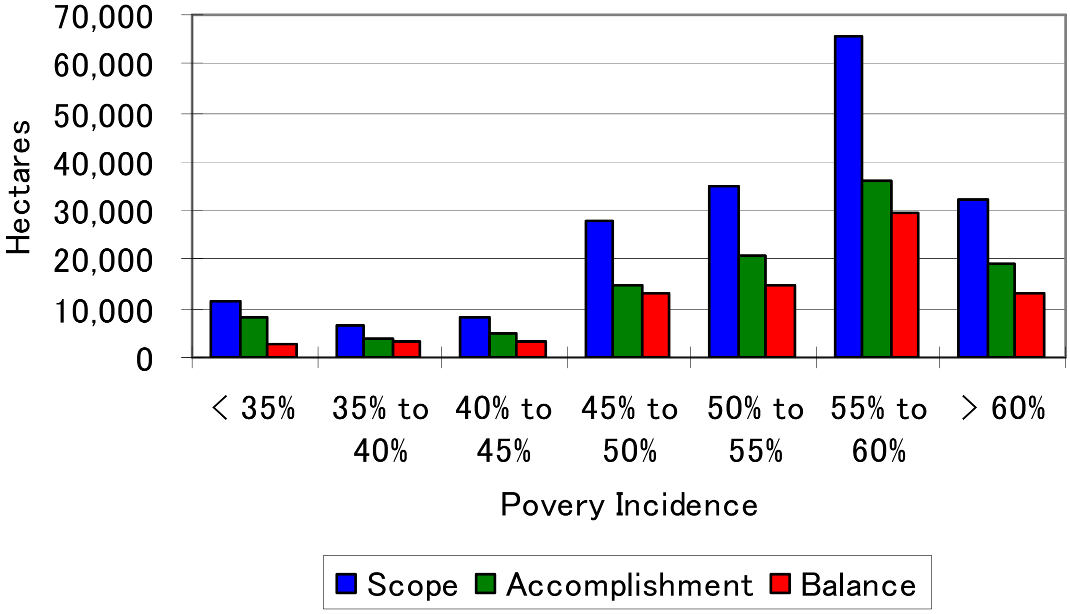
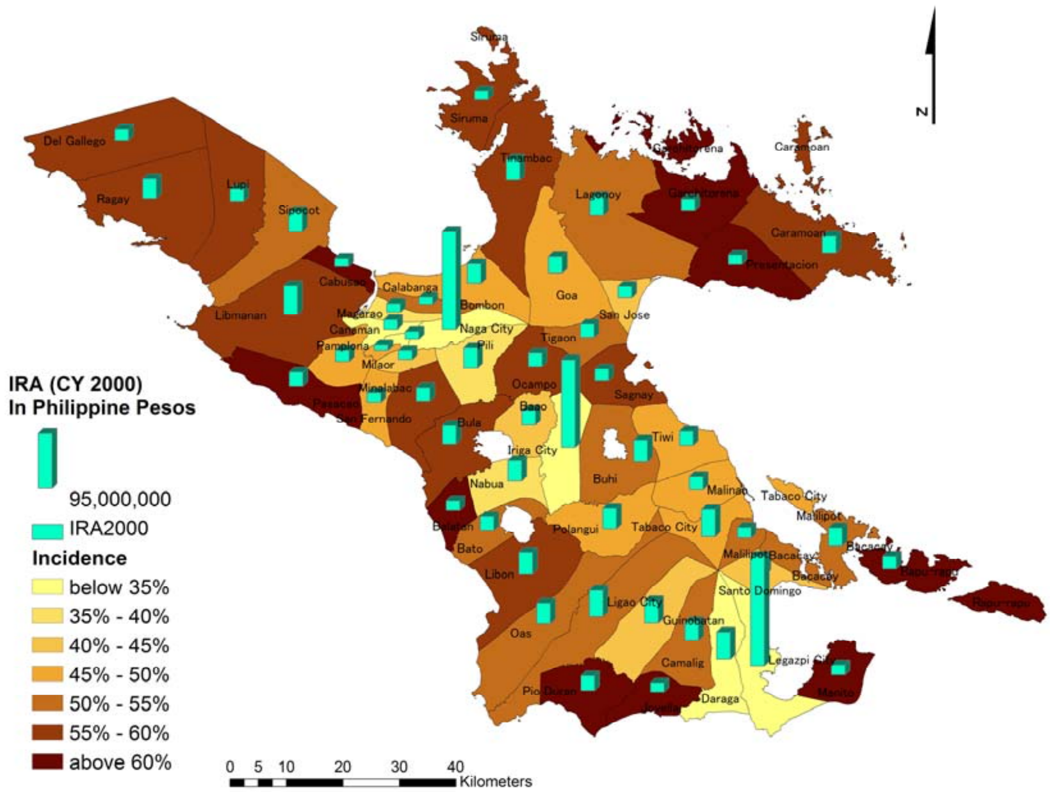



**Figure 24: Proportion of land distribution under the Comprehensive Agrarian Reform Program by level of poverty incidence in Albay and Camarines Sur Provinces as of CY 2000**




**Map 16: Spatial distribution of Internal Revenue Allotment and poverty incidence**

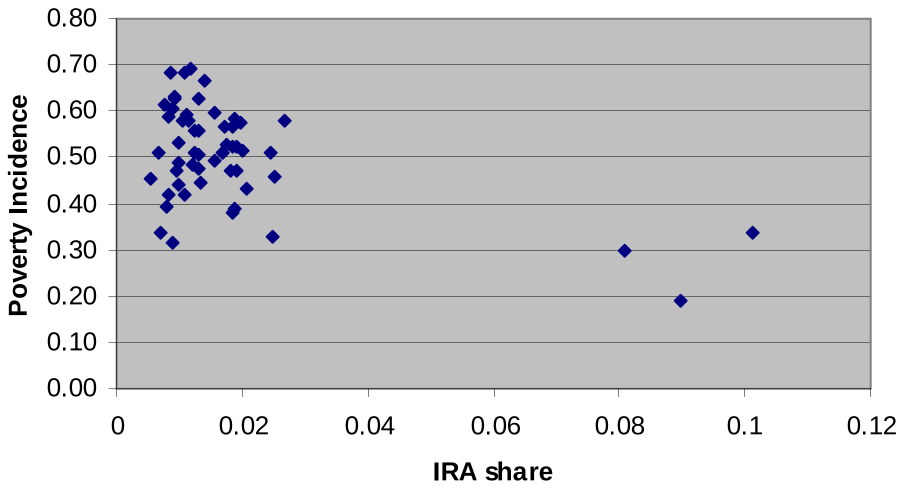
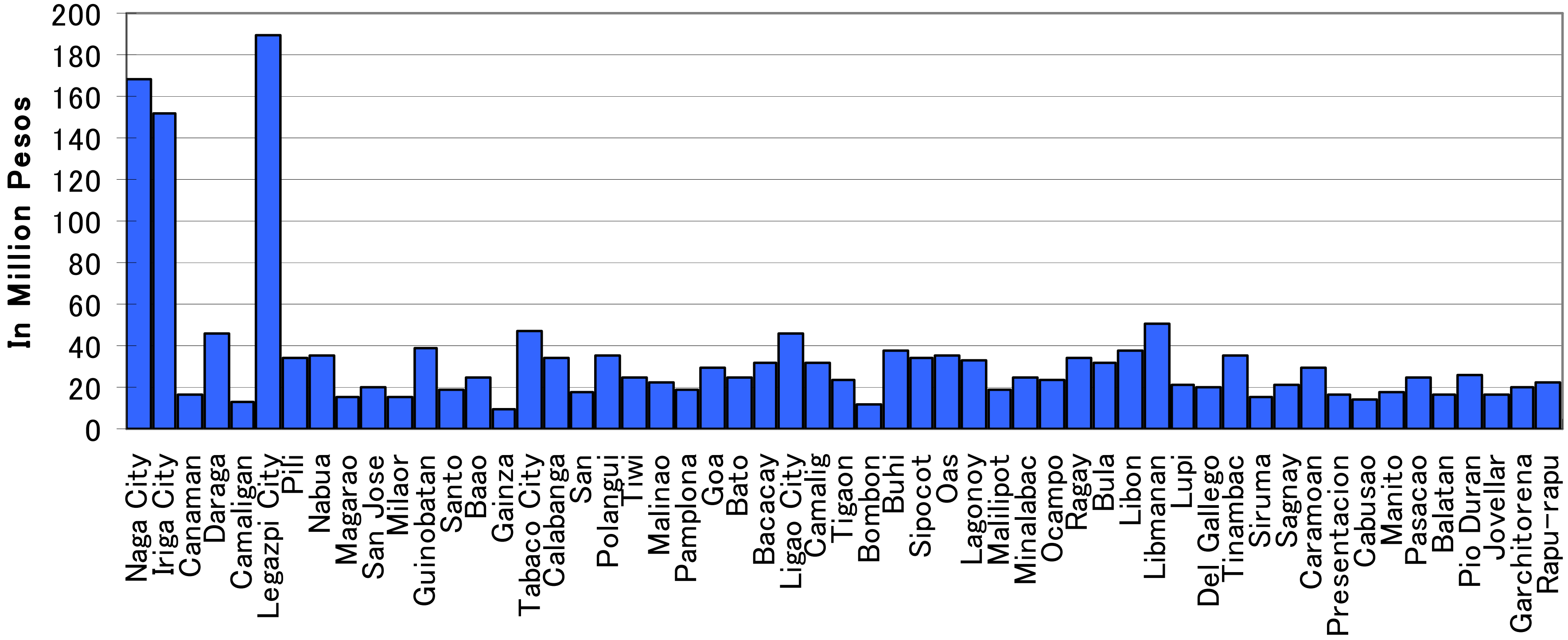



**Figure 25: Percentage of share in Internal Revenue Allotment vs. poverty incidence in the study area**




*Source: Department of Budget and Management*

**Figure 26: CY 2000 Internal Revenue Allotment by city/municipality in Albay and Camarines Sur Provinces**

Note: The geographical representation of this graph is presented in Map No. 16

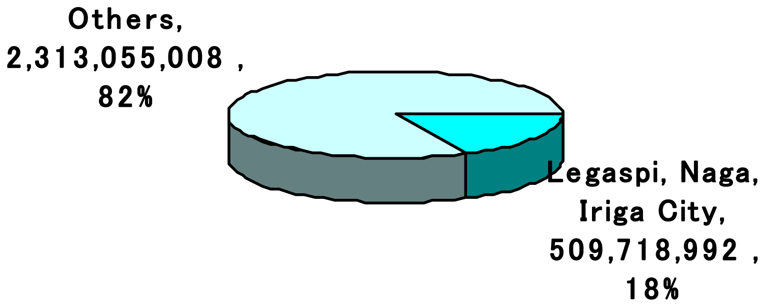



**Figure 27: Proportion of IRA distribution in Albay and Camarines Sur Provinces as of CY 2000**

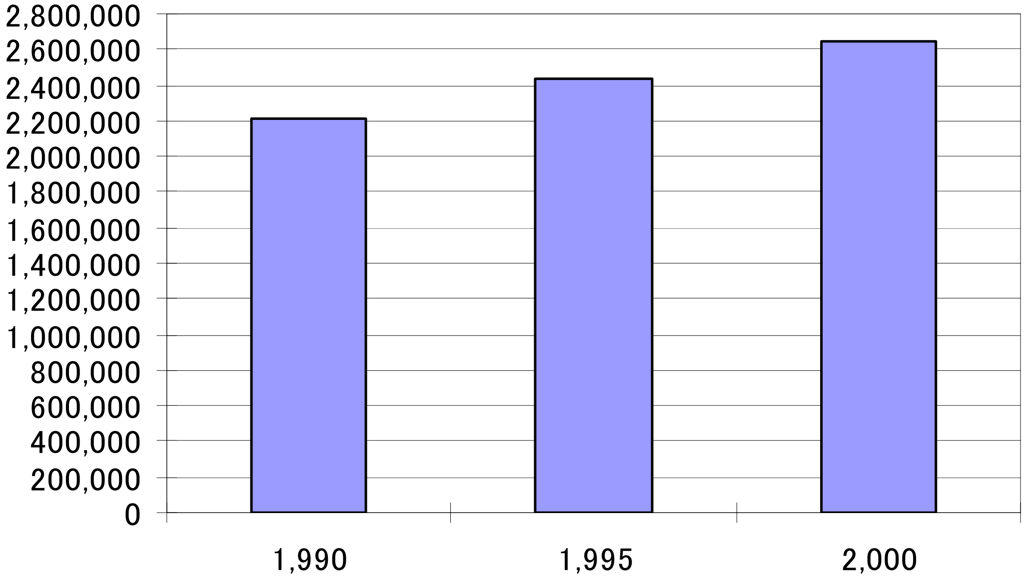



**Figure 28: Total population count in Albay and Camarines Sur Provinces (1990 – 2000)**

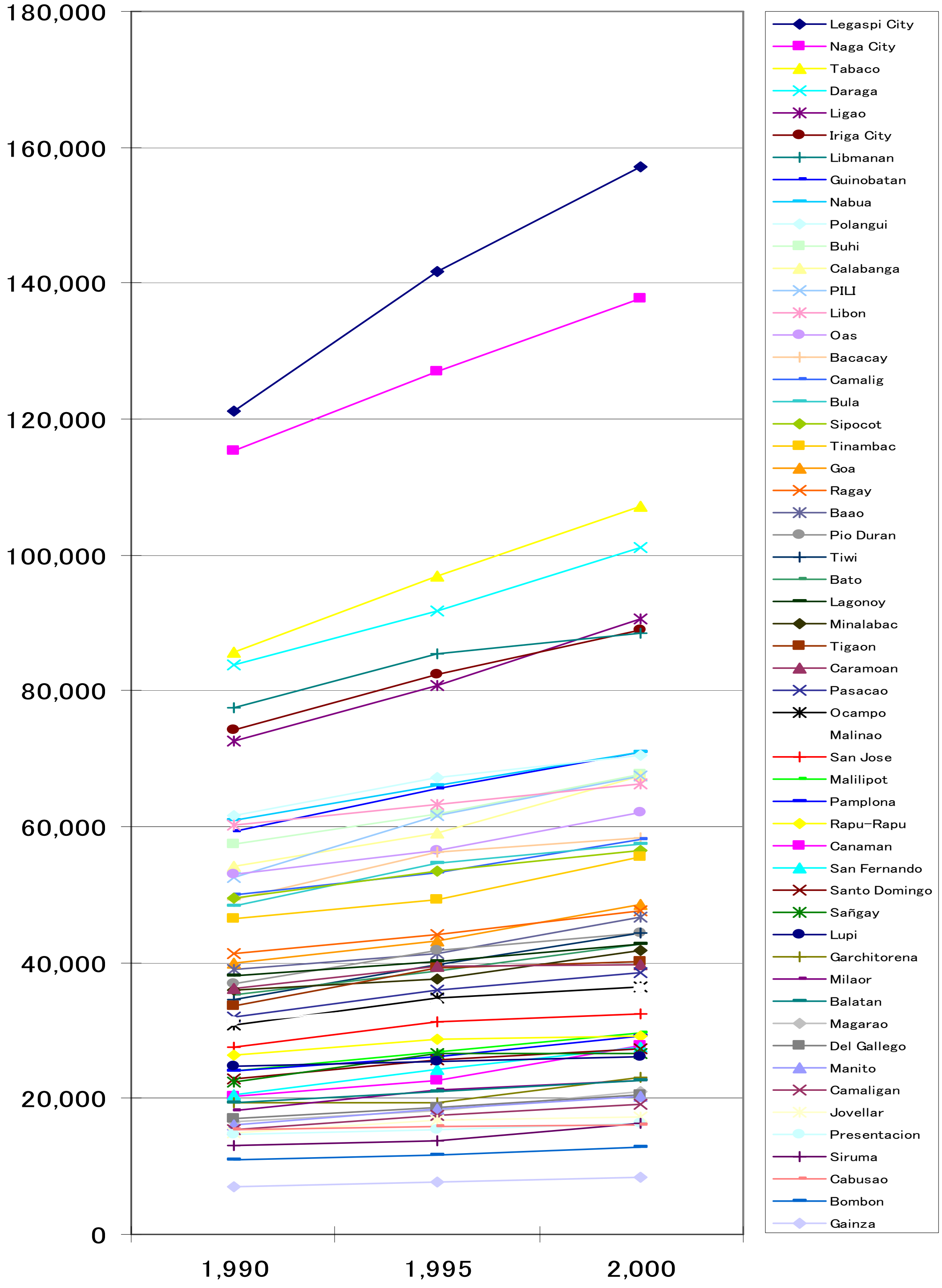
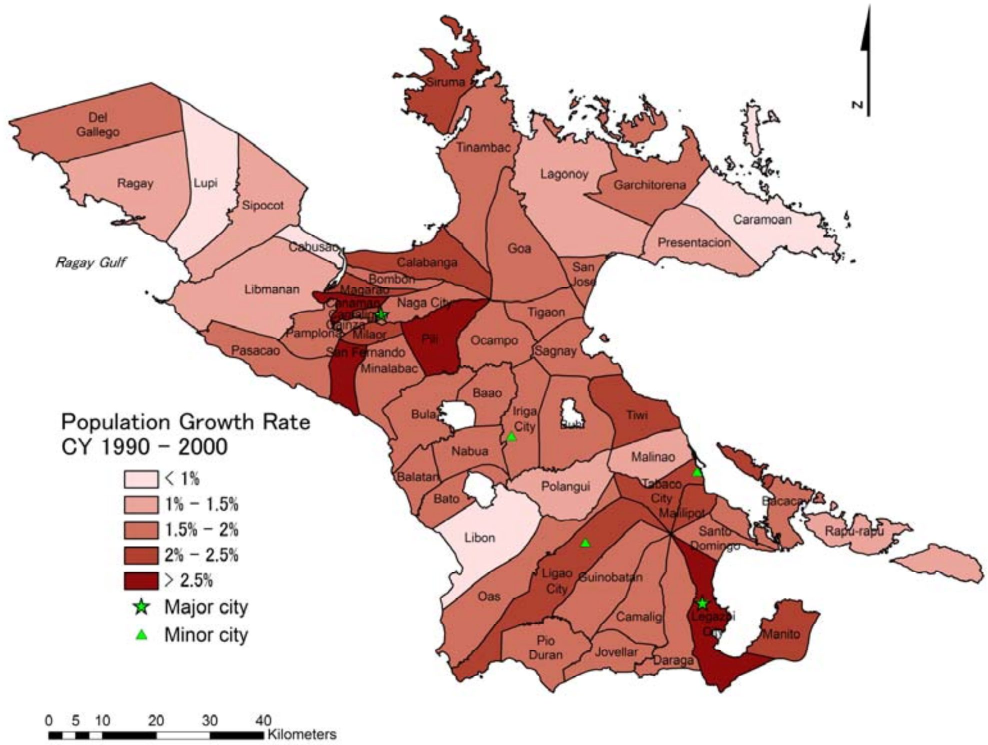



**Figure 29: Population growth by city/municipality in Albay and Camarines Sur Provinces (1990 – 2000)**




**Map 17: Spatial distribution of population growth rate (1990 – 2000)**

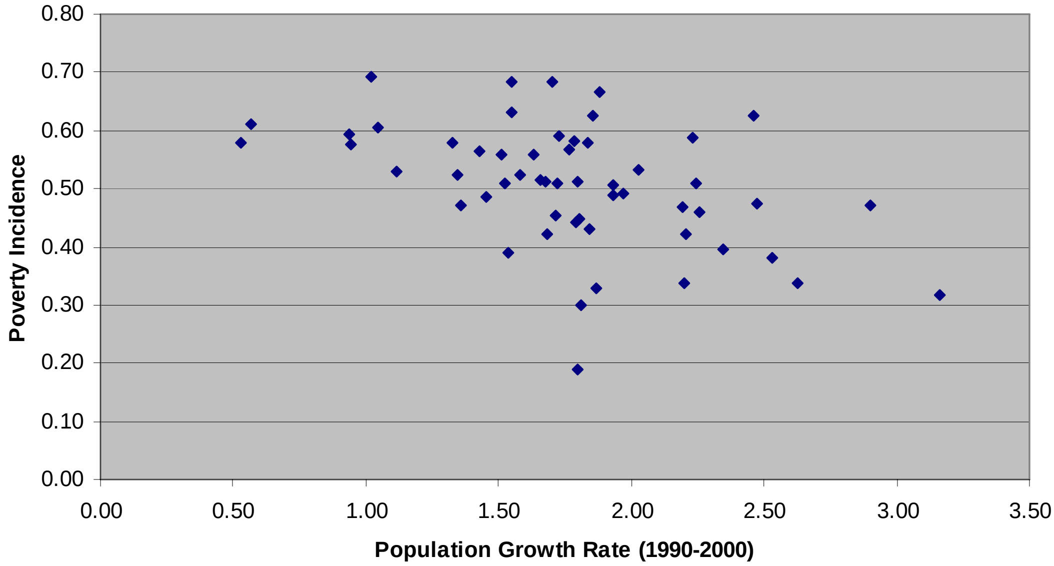



**Figure 30: Population growth rate vs. poverty incidence in the study area**

## 5.6 Discussion of the Results of the Multivariate Regression Analysis on the Determinants of Poverty

After taking a look at each of the variables, a multiple regression analysis was executed combining the ten (10) different variables i.e., elevation, slope, soil, rainfall, river access, road access, proximity to major markets, land distribution, fiscal decentralization and population growth, to explore which of these independent variables significantly affect the dependent variable, poverty incidence which represent poverty condition in every locality. Results of the multiple regression analysis are shown on the next page.

Results show that the regression model could explain 83.2% of variation in poverty incidence in the study area as indicated by the value of $R^2$ (Table 9). Meanwhile, Analysis of Variance (ANOVA) shows the goodness of fit of the model, and in this case it is statistically significant at 0.05 (Table 10). In other words, the regression model has the ability to explain the determinants of poverty. On the other hand, bivariate correlations shows that none of the variables have a correlation coefficient greater than 0.8 (Appendix 1). This means that collinearity among the independent variables is non-existent. Similarly, the histogram below (Figure 31) and the P-P plot of the residual (Figure 32) suggest that the residuals are probably normally distributed.

Accordingly, four (4) out of ten (10) (marked as *) variables are strongly and statistically significant at 0.01 (see Table 11). These include mean road density, share in Internal Revenue Allotment, agrarian reform accomplishment rate and population growth rate. As such, there is a very strong significant relationship that exists between poverty incidence and these factors; they are best predictor for the level of poverty within the study site. In the same way, four (4) other variables are less strong determinant but still statistically significant at 0.05 (marked as **). These are as follows: distance to major cities, mean elevation, percentage of slope above 8%, and mean annual rainfall. Of all the variables, mean road density is the strongest influential determinant to poverty as reflected by its high standardized coefficient. This is followed by share in IRA. In contrast, soil with agricultural limitations and mean river density do not have a statistically significant effect on poverty incidence.

**Table 9: Multiple regression model summary**

| R | $R^2$ | Adjusted $R^2$ | Standard Error of the Estimate |
|---|---|---|---|
| 0.912 | 0.832 | 0.794 | 0.0478069 |

**Table 10: ANOVA table of multiple regression**

| | Sum of Squares | Degrees of Freedom | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 0.499 | 10 | 0.050 | 21.812 | 0.001 |
| Residual | 0.101 | 44 | 0.002 | | |
| Total | 0.599 | 54 | | | |

**Table 11: Multiple regression coefficients**

| Variables | Indicator | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | S.E. | Beta | | |
| | Constant | 1.469 | 0.416 | | 3.530 | 0.001* |
| Elevation | Mean Elevation | -0.0002 | 0.000 | -0.215 | -2.221 | 0.032** |
| Slope | Percentage of slope above 8% | 0.101 | 0.044 | 0.248 | 2.267 | 0.028** |
| Soil | Percentage of soil with agri. Limitations | -0.0218 | 0.027 | -0.070 | -0.797 | 0.430 |
| Rainfall | Mean annual rainfall | -0.0002 | 0.000 | -0.181 | -2.145 | 0.037** |
| River access | Mean river density | -0.0532 | 0.063 | -0.082 | -0.841 | 0.405 |
| Road access | Mean road density | -0.111 | 0.024 | -0.490 | -4.660 | 0.001* |
| Proximity to major markets | Distance to major cities | 0.0007 | 0.000 | 0.186 | 2.139 | 0.038** |
| Land distribution | Agrarian reform accomplishment rate | 0.141 | 0.049 | 0.212 | 2.847 | 0.007* |
| Fiscal decentralization | Share in Internal Revenue Allotment | -1.798 | 0.411 | -0.314 | -4.370 | 0.001* |
| Population growth | Population growth rate (1990-2000) | -0.0427 | 0.015 | -0.208 | -2.827 | 0.007* |

*Significant at 0.01

** Significant at 0.05

As mentioned above, the results of the multiple regression analysis reveal that mean road density is the strongest influential determinant to poverty as reflected by its high standardized coefficient of -0.490. This finding implies that low road density posts high incidence of poverty. Limited access to road infrastructure significantly affects the state of poverty in every locality. Roads are basic infrastructure for development. Lack of roads will not spur economic investment that will generate employment and income for the local people. It interrupts the mobility of people, goods and services. It also derails people's access to opportunities such as work, education and even health services. Apparently, more access to road infrastructure notably lowers poverty rate.

Furthermore, a glance at the status of existing national road by surface type (Table 12) also reveals that long kilometers of roads in the study site are still covered by gravel (see Figure 33 showing gravel road landscape). Gravel roads constitute about 356 kilometers while concrete and asphalt roads make up about 441 and 170 kilometers, respectively. Although road surface type was not considered in the regression analysis, this condition would certainly affect intra-regional marketing as well as hauling cost of agricultural products to be sold in the local and major markets. As a result, this would eventually lower income derived from agricultural activities.

**Table 12: Existing national road length by surface type by province as of CY 2000 (in kilometers)**

| Province | Concrete | Asphalt | Gravel |
|---|---|---|---|
| Albay[1] | 193.8900 | 61.5000 | 87.46 |
| Camarines Sur | 231.8100 | 93.2000 | 267.7100 |
| Naga City | 15.6100 | 15.7030 | 0.5140 |
| Total | 441.3100 | 170.4030 | 355.6840 |

Source: Regional Socio-economic Trend 2001, Metro Naga Development Council

[1]No data for Legaspi City

In addition, existing inter and intra-regional transportation network in the study site could also possibly explain the spatial variation in poverty incidence. For instance, the effect of the national road named as Maharlika Highway is visible to see when overlaid with the choropleth map of poverty incidence (Map 18). A single paved road, Maharlika Highway passes through the mountains of south Luzon and connects the rest of Bicol mainland to Manila via the Province of Quezon. It also serves as the major transportation route across municipalities within the study area. As seen from the map, usually, municipalities where the Maharlika Highway passes through have relatively lower poverty rate possibly because they have easy access to Manila and key cities in the region. But during the worst of the typhoon season, even this road becomes tenuous as its sections are washed out and collapsed down the side of steep mountains. Thus, the study site becomes physically isolated from the rest of Luzon and Manila.

More so, it is surprising to note that some areas i.e., *barangays*, even though not islands are accessible only by rivers. For instance, some *barangays* within the riverine towns of Minalabac, Gainza, Pamplona and Libmanan have access to Naga City through rivers. These are served by motorized boats utilizing the small wharf right behind the Naga City Public Market. Also as expected, the isolation of Rapu-rapu Island from the rest of the region is no doubt one of the leading causes of poverty in that municipality. The island is only accessible by boats called *banca* that cruise from its *poblacion* to the city port in Legaspi City. Except its town center, the whole island is almost completely inaccessible by any road infrastructure.

All of these findings suggest that road infrastructure is not better in the study site thereby limiting travel, marketing, agro-industrialization and regional development within the confined of cities and its corridor while leaving the rest as impoverished communities.

The low access to road infrastructure is further exacerbated by disparities on internal revenue allotment which was also found to be a strong determinant to poverty. As indicated in the results of the regression analysis, it is the second most significant determinant to poverty with a standardized coefficient of -0.314. Again, as discussed in the preceding section, municipalities with lower share in IRA exhibit high poverty incidence. No wonder the lower share in IRA suggest meager funds for development such as road infrastructure and subsequently, high poverty rate. To put it differently, the national government provides greater fiscal support to better-off localities i.e, cities than to poor municipalities.

Why do the better-off LGUs receive more IRA than the poorest localities? An examination of the Local Government Code reveals that population, land area, and equal sharing are the only criteria for computing IRA of every LGU. The state of poverty is not considered as a criterion. According to the guidelines, 23% of the total IRA for every fiscal year is shared by more than 130 cities whereas 34% must be divided to almost 1,500 municipalities. No wonder, cities would receive higher IRA because they usually have high concentration of the population and there is less competition among them in IRA allocation. Thus, this finding further suggests that the fiscal decentralization policy itself is geographically biased to cities which notably are more affluent than most municipalities. There seems to be loopholes in the fiscal decentralization policy as a strategy for local development to alleviate poverty in the countryside.

On the other hand, agrarian reform accomplishment rate unexpectedly generated a positive regression coefficient which is statistically significant at 0.01 in the regression analysis. This means that high percentage of land distribution may have further increase the rate of poverty which contradicts our previous assumption. Such findings may suggest that, it is not quite clear if the agrarian reform program of the national government as represented by the rate of land distribution has truly contributed to poverty reduction. On the contrary, it may have aggravated poverty. As such, some analysts assert that land distribution has led to land fragmentation. As a matter of fact, the average size of farms given to farmer beneficiaries in this area is less than 1 hectare only. Because of this, agrarian reform may have caused inefficiency and food insecurity because of the loss of economies-of-scale in production, and thereby reduction in farm income. Furthermore, land distribution alone is not enough without the provision of much needed support services such as farm-to-market roads, irrigation and post harvest facilities. This could be one of the reasons why in bivariate correlation, land distribution was not statistically significant but it became significant in multiple regression result. In others words, land distribution is closely intertwined with road infrastructure. Agricultural lands without access to roads would not uplift the poor farmers from the shackles of poverty and reduce its incidence. Unfortunately, these basic infrastructures are lacking as reflected in the low access to road infrastructure in most of the poorest localities. Nonethelss, a more detailed local study would be needed to validate this claim.

Regression result also shows that population growth rate yielded a negative coefficient of -0.208 and is statistically significant at 0.01. This means that the rate of population growth contributes to decreasing poverty incidence, which disproves our assumption that population growth exacerbates poverty condition. Migration could be one of the major reasons that could further explain this finding. People from the poorest areas would most likely migrate to more affluent areas thereby inducing higher population growth rate in the latter. Probably it is not population growth rate that is a factor that may affect the state of poverty but natural fertility rate. More so, this finding further suggests a question of causality. While most analyses have focused on population growth as an original cause of poverty, it may by itself a consequence of poverty rather than its cause. A detailed study to address this issue is also needed.

Meanwhile, results of the regression analysis also reveal that proximity to major markets is a significant determinant to poverty at a 95% level of confidence. Its positive standard regression coefficient of 0.186 means that farther distance from major markets as represented by major cities increases the level of poverty rate. This finding also implies that most localities in the two provinces are still highly dependent on major cities being the center of commerce, trade, industry and employment (see Figure 34 showing an example of a poor vendor selling vegetables in the city market). As a matter of fact, by examining the local revenues in this region reveals that the two major cities – Naga and Legaspi - generated more revenues from business establishments as well as real properties than the rest of the LGUs combined revenue earnings (Figure 35), an indication of the high concentration of development and economic activities in the two cities. Since most of the businesses, enterprises, offices, industries, including higher educational institutions are located in these cities, the state of development within these cities influences the state of development and consequently poverty condition in their surrounding municipalities. This explains why municipalities closer to Naga City such as Canaman and Camaligan and to Legaspi City such as Daraga have relatively low poverty incidence. On the other hand, people living in farther municipalities would find it difficult to transport and market their agricultural produce to key cities because of distance which is further exacerbated by road pavement condition. Thus, economic development in the study site is highly concentrated in these cities while the rest remains to depend on their agriculture-based and small-scale economy.

Similarly, three of the five agro-climatic variables i.e., slope, elevation and rainfall were all found to be significant determinant to poverty. The percentage of slope above 8% generated a relatively higher positive standard regression coefficient of 0.248 at 95% level of confidence. As such, the slope characteristics also reveal a strong determinant to poverty.

Predominantly located in the mountain ranges in the Caramoan Peninsula, Ragay Coast and its surrounding area, as well as in the southwestern part of Albay and the island municipality of Rapu-Rapu, these areas which have greater percentage of slope above 8% characterized as rolling, hilly and steep slopes normally have possible geographical disadvantage in agricultural activities because of rolling to hilly and steep slope features, a condition not suitable for irrigation particularly the gravity type which is the dominant irrigation facility in the region. Accordingly, these areas are mostly cultivated with perennial crop or covered by forest and brushland (see Map 19 for a comparison with Landcover/use Map produced by the Philippines' National Mapping and Resource Information Agency - NAMRIA). Coconut is the most cultivated perennial crop grown in this area based from NAMRIA's land cover mapping study. It approximately covers 240,000 hectares of land which constitute about 32% of the total land area (Figure 36). Forest and brushland, on the other hand, consists of 65,000 hectares and 194,000 hectares, respectively. As such, it is more likely that localities with high percentage of coconut plantations are relatively poorer probably because the farmers could not engage in high yield variety of crops due to slope limitations. This condition is further exacerbated by the decline of coconut production over the past three years from 1998 to 2000 (see Figure 37). On the other hand, lands with slope 0 to 8%, mostly located in the Bicol valley are generally agricultural lands planted with rice, corn and abaca (see figure 39 and 40 showing the agricultural landscape). Furthermore, the slope characteristics certainly influence the network of road infrastructure within the study site. It is difficult and much more expensive to construct roads in areas with steeper slopes than in flat plains. This is the reason why localities in the Bicol plain have more access to roads than in Caramoan peninsula and other mountainous areas because of slope barriers.

In the case of elevation and rainfall, both are are also statistically significant at 0.05. Yet this is quite unexpected since these two are not statistically significant in the bivariate correlation analysis. Furthermore, from a positive correlation coefficient, their regression coefficient changed to a similar negative value of -0.0002. This value seems to be quite low to say that generally elevation and rainfall has an inverse effect on poverty, that is, highly elevated areas would be less poor than low lying areas and that higher rainfall would mean less poverty incidence. Instead this suggests that the effect of elevation and rainfall to the level of poverty incidence vary widely by locality.

Most likely, elevation has a more significant effect to those municipalities lying in mountain ranges i.e, Caramoan Peninsula and Ragay Coast, where their topographic features limit their ability to engage in various agricultural and economic activities. Meanwhile, rainfall would be beneficial for farmers in the small coastal plains, especially farmlands in Caramoan Peninsula, since they have little access to irrigation facilities as compared to most of the farms in the central plain. Likewise, the relatively low amount of rainfall affects the small rainfed agricultural farms in the western coast.

On the other hand, the great amount of rainfall poured in low lying municipalities within the Bicol plain, especially those located nearby the mouth of San Miguel Bay, caused massive floods each year. According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAG-ASA), these flood-producing rains from May to February are mainly due to tropical cyclone passages and northeast monsoon rains. Through much of the year, the region is battered by frequent typhoons from the Pacific, bringing high winds and heavy rains. As a matter of fact, the Bicol region is well known as the typhoon gateway of the Philippines. For the past 50 years, more than 27 most intense typhoons directly hit Bicol (see Appendix 3). These typhoons caused perennial flooding and destroyed crops and homes, pushed saline water into interior rice fields and caused widespread silting and erosion. This further explains why there are also municipalities with relatively high incidence of poverty in the Bicol plain. Although the Bicol valley is mostly devoted to agriculture because it has no slope and elevation limitations, it possesses geographical disadvantage due to its low lying topography which is prone to flooding caused by heavy rainfall and typhoons. Hence, the unsuitable climatic condition for agricultural production of the region in general, and in the Bicol plain in particular, is undoubtedly one of the major factors that would explain the spatial variations of poverty.

On the other hand, although river access has a strong correlation with poverty incidence as discussed in the preceding section of this chapter, regression result revealed that access to river is not a statistically significant determinant. Reasons for this may not be found elsewhere except by relating it with the status of irrigational development of the area. According to the CY 2002 Census of Agriculture, out of the total 142,000 hectares of farms surveyed, 27% or 38,000 hectares of these have no access to irrigation (Table 13). Meanwhile, the National Irrigation Administration (NIA) reported that out of the total 170,000 hectares of irrigable lands, only approximately 70,000 hectares have access to different types of irrigation systems in the two provinces (Figure 38). Moreover, most of the existing irrigation systems covering a total service area of about 50,000 hectares have already deteriorated over time according to the Regional Development Council (RDC).

**Table 13: Status of irrigational development in the two provinces**

| | **Albay** | **Cam. Sur** | **Total** | **%** |
|---|---|---|---|---|
| Number of Farms Reporting | 24,341 | 62,884 | 87,225 | 100% |
| Total Area of farms | 34,740 | 107,110 | 141,850 | 100% |
| Area of Parcels with Irrigation | 23,825 | 79,950 | 103,775 | 73% |
| Area of Parcels without Irrigation | 10,915 | 27,160 | 38,075 | 27% |

Source: CY 2002 Census of Agriculture, National Statistics Office

Furthermore, although the Bicol River and its tributaries are the major source of irrigation in the region, their adjacent areas suffer from saline intrusion brought about by tidal backwater effect and storm surges from the mouth of San Miguel Bay which traveled upstream during the typhoon season. This incident had put limitations on the use of water for irrigation according to the report of the RDC. The lack of access to irrigation, deteriorating irrigation facilities and saline intrusion causing irrigational limitation would explain why access to river, as such, a non-significant determinant to poverty. This may also explain why rainfall is more significant determinant to poverty than river.

Finally, and as expected, the percentage of soil based on the presence or absence of constraint to agriculture was a non-significant determinant to poverty. Perhaps, the suitability of crops planted according to the type of soil and its productivity would be more influential to poverty than the soil texture alone. Another possible reason would be the quality of soil data collected. A higher resolution same as the 90-meter SRTM would possibly needed to reveal significant correlation with poverty. A more detailed study is needed to address this issue.

In summary, agro-climatic conditions of the study site reveals disparity in the distribution of the natural resource endowments. The northwestern section of the study area (Caramoan Peninsula), the island municipality of Rapu-rapu and the eastern and western coast seems to be geographically disadvantageous in terms of their topography. These areas mostly lie within hilly and sloping terrains with a few small plains devoted for farming. The central plain seems to be the most advantageous part because of its low lying and flat topography, yet it suffers from the effect of weather disturbances i.e., typhoons which caused floods and damages to agricultural production and properties. More than anything else, access and proximity plays a very crucial role in explaining the spatial variations of poverty in the study area. Low access to road infrastructure was notably found in poorest areas of the region. Farthest from major economic centers were normally the poorest areas. These findings further reveal that the state of poverty in the region is truly a spatial phenomenon that involves inter-linkages among the different localities. This situation is further aggravated by bias in fiscal funding and seemingly failure of the 20 year old land distribution program of the national government.

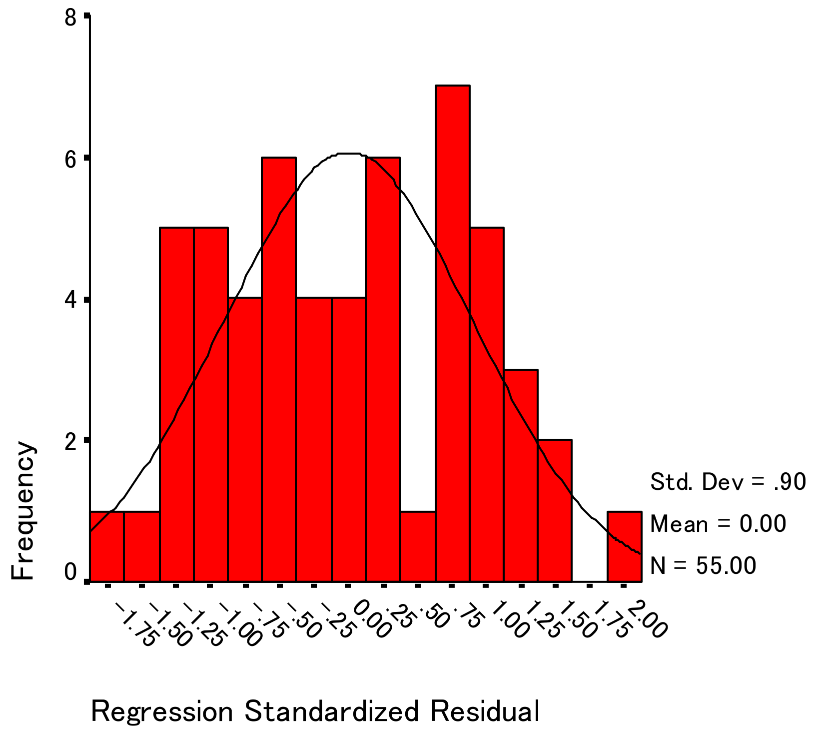



**Figure 31: Histogram of standardized residual**

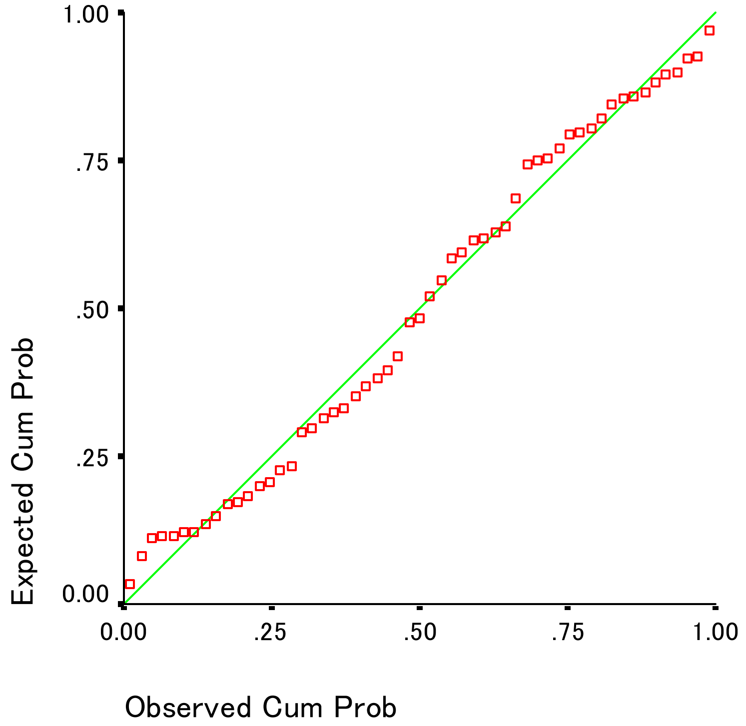



**Figure 32: Normal P-P Plot of residuals**

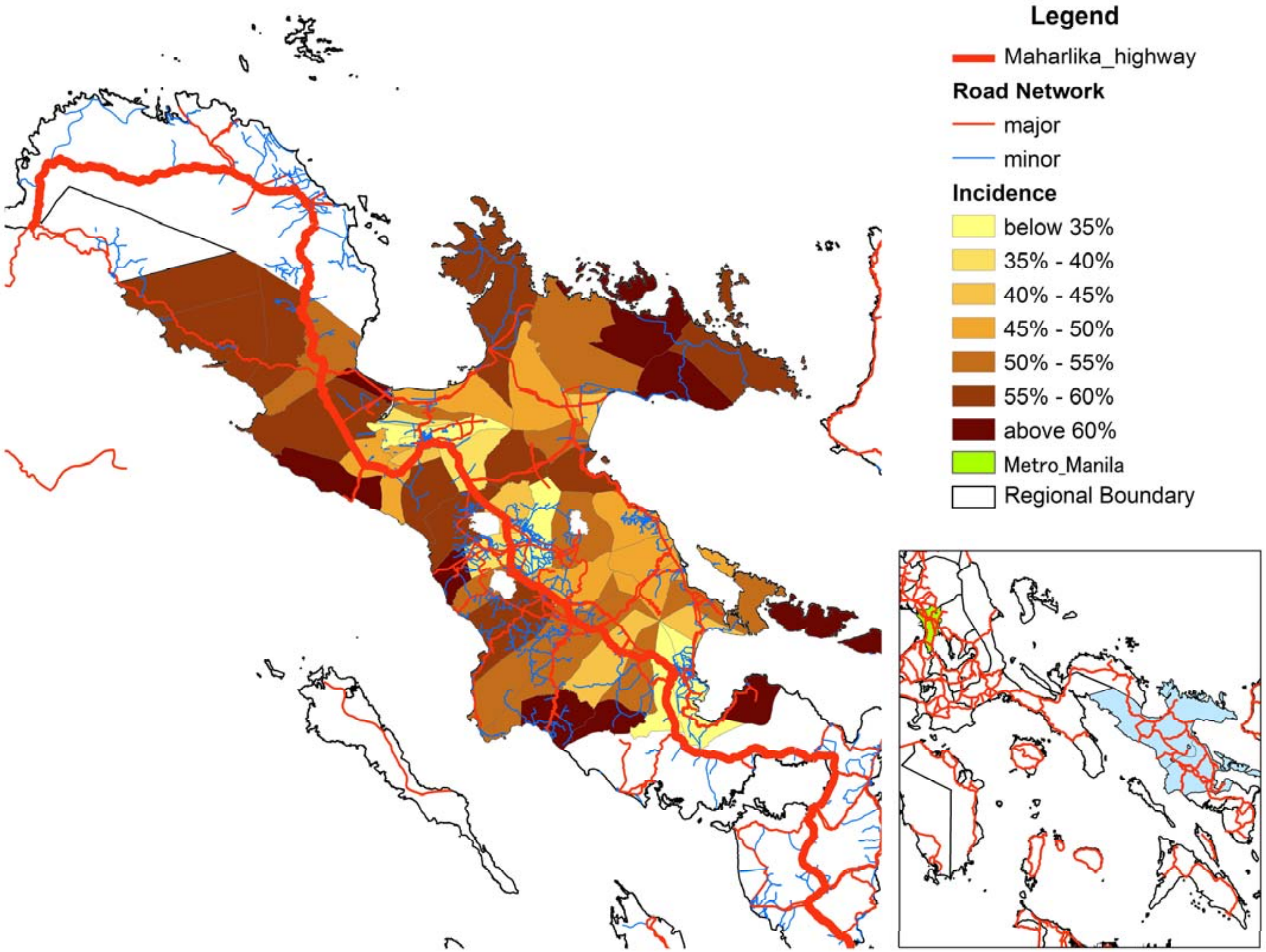
**Figure 33: Rural road in Barangay Yabo, Sipocot, Camarines Sur**

Note: Overloaded transportation is a norm to transport goods and people to the market and maximize profit for the jeepney driver.

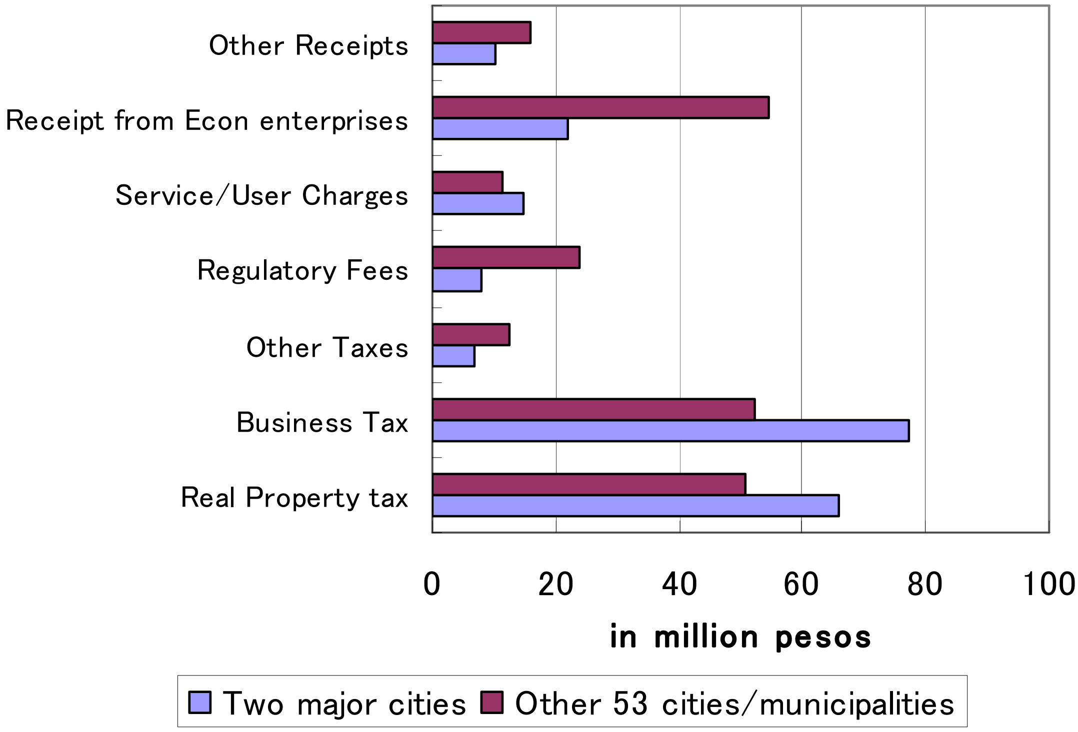
(Photo taken by Ron Nieuwsma, an American missionary)

**Figure 34: Poor vendor selling vegetables in Public Market in Naga City**

(Photo taken by Christian Razukas)

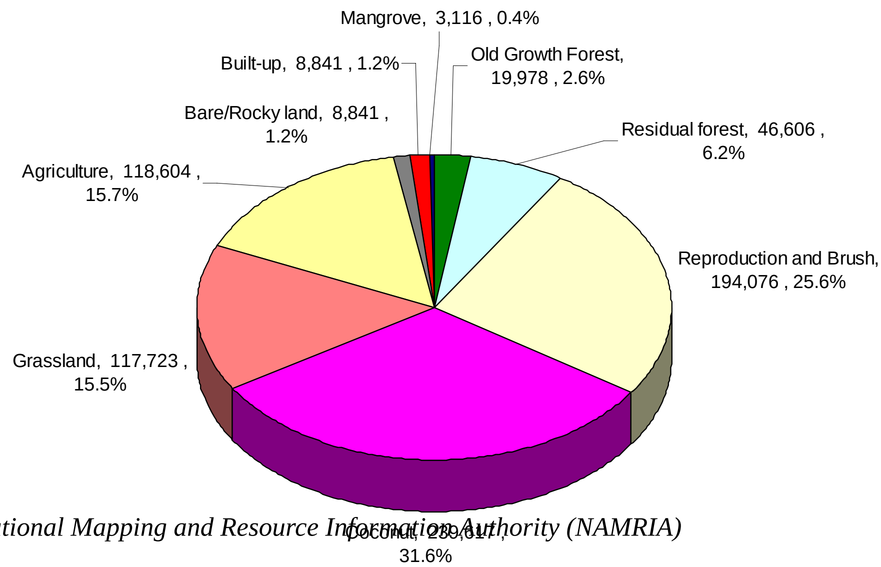



**Map 18: Road network and poverty incidence in the study area**



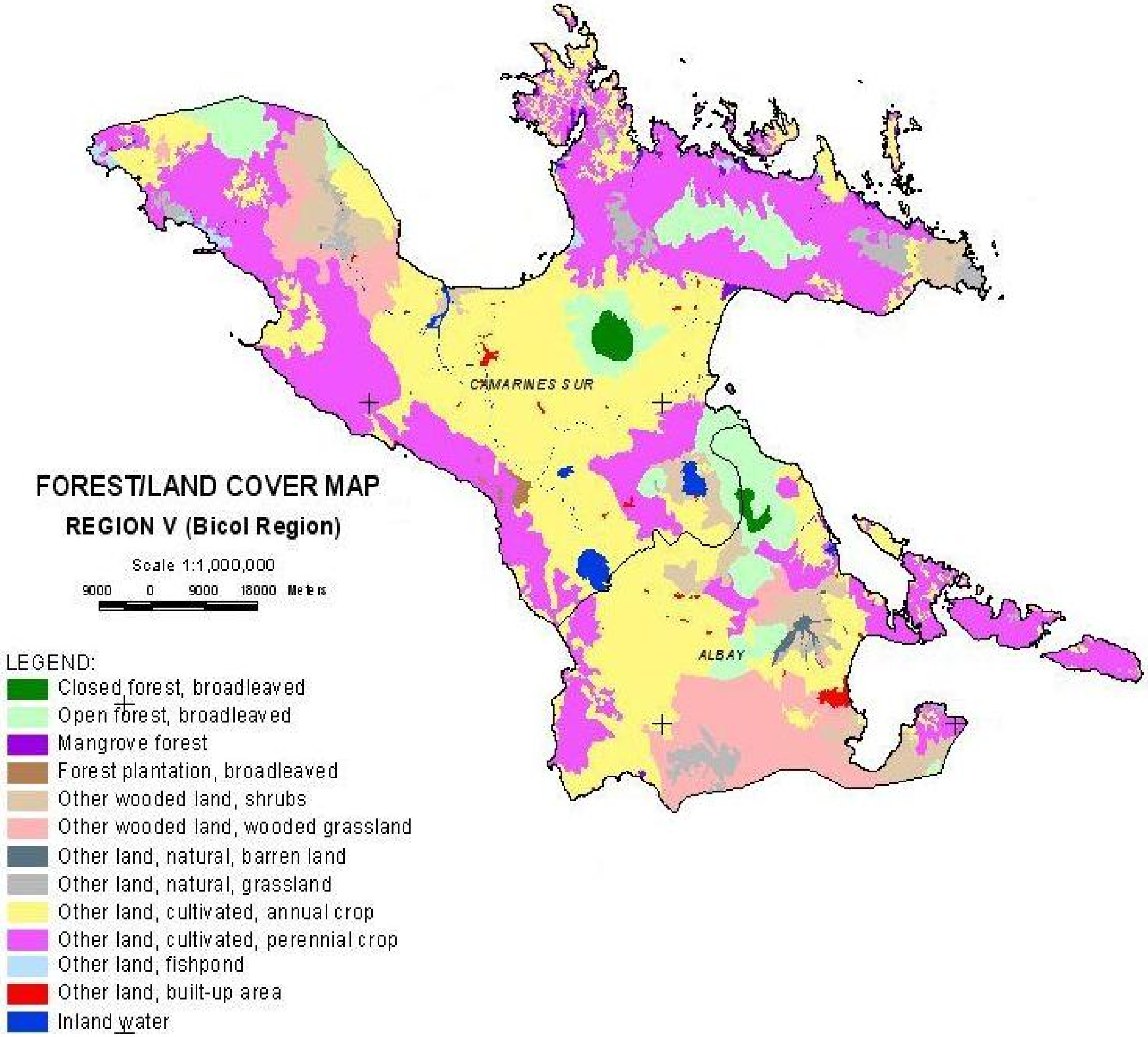

*Source: Bureau of Local Government Finance*

**Figure 35: LGU Revenue Sources in Albay and Camarines Sur Provinces in CY 2001**



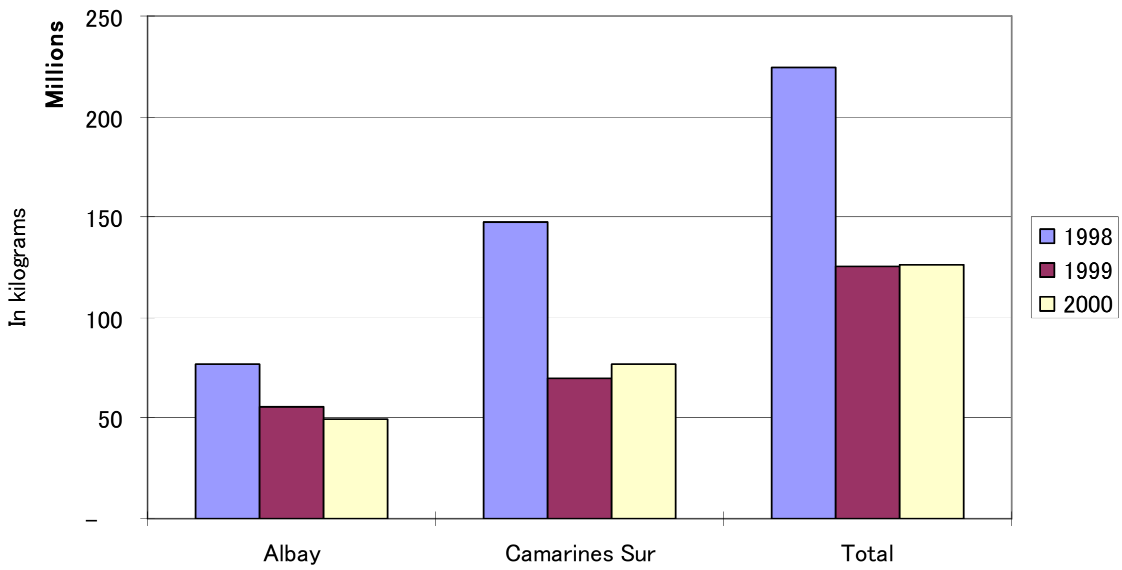

*Source: National Mapping and Resource Information Authority (NAMRIA)*

**Figure 36: Land cover distribution**



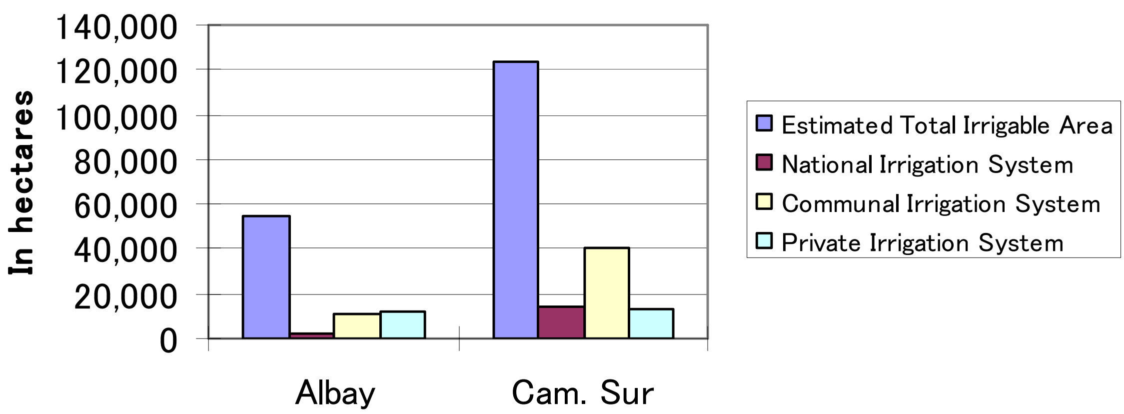

*Source: National Mapping and Resource Information Authority (NAMRIA)*

**Map 19: Land cover map**




*Source: Bureau of Agricultural Statistics, Region V*

**Figure 37: Coconut Production in Albay and Camarines Sur Provinces (1998-2000)**




*Source: National Irrigation Administration*

**Figure 38: Status of irrigational development by type in Albay and Camarines Sur Provinces as of CY 2002**

**Figure 39: A farmer preparing the field with his carabao**

Note: Mayon Volcano as viewed from Tiwi, Albay

(Photo taken by Salve Canale)

**Figure 40: A poor coconut farming village in Bicol**

(Photo taken by Janice Acdal)

# Chapter 6

# Conclusions

## 6.1 Conclusions

This study explores the spatial patterns and determinants of poverty in the two provinces – Albay and Camarines Sur – both located in one of the poorest region in the Philippines, Bicol Region. This research also demonstrates the use of GIS in exploring the spatial dimension of poverty. By using GIS, the spatial patterns of poverty, measured in terms of incidence, reveal spatially heterogeneous characteristics. Poorest areas, on the one hand, are spatially concentrated in Caramoan Peninsula and several municipalities along Ragay Coast and in Rapu-rapu Island and some portions of the eastern and southern Albay. On the other hand, most affluent areas are spatially concentrated in key cities and their surrounding municipalities.

Likewise, poorest areas are sparsely populated yet the total poor population in these areas far exceeds the total poor in better off localities. They are normally characterized by mountainous features with hilly, sloping and steep terrains possessing agricultural limitations. Moreover, poorest areas strongly coincide with low access to road infrastructure as reflected in low density of roads and relatively distant from major cities of Naga and Legaspi. They are also isolated from the rest of the region, like Rapu-rapu Island, the poorest municipality.

However, poverty incidence, in general, varies widely across the region, especially in the Bicol valley and alongside coastal areas. Although situated in flat, low lying and gently sloping lands comprising of vast agricultural lands, with high access to road infrastructure, river resources and nearness to major markets, yet municipalities in this area suffer from the effect of heavy rainfall due to frequent typhoon passages which further caused massive floods and damages to agricultural production and properties, annually. This undoubtedly aggravates poverty condition especially in the agricultural sector which is most vulnerable to calamities.

Furthermore, several poorest municipalities are also highly covered by the agrarian reform program of the government, suggesting that these areas are mostly devoted to agriculture. The effect of the rate of accomplishment in land distribution, nonetheless, differs by locality but generally suggests a negative effect on poverty which is most likely due to inefficiency brought about by lack of support services such as farm-to-market roads and irrigation facilities, among others. The spatial distribution of budgetary allocation in the form of Internal Revenue allotment is highly skewed to better-off cities while the rest of the localities received meager funding for local development. Lastly, high population growth rate normally coincide with more affluent areas than with the poorest localities. This may imply that migration might be the cause of high population growth rate suggesting further that population growth may by itself a consequence of poverty rather than its cause.

Therefore, this reaseach concludes that spatial variation in the incidence of poverty is mainly caused by disparities on access to road infrastructure which is further exacerbated by loopholes and geographical bias in fiscal funding priorities for local development and deficiency in agrarian reform implementation. Moreover, proximity to major cities where there is a high concentration of development and economic activities and differences in agro-climatic features, particularly, elevation, slope, and rainfall, also proved to be significant determinants to poverty and suggest the presence of geographically disadvantageous areas within the study site. Basic infrastructures such as roads that are deemed important to spur agro-industrial and rural development which will generate income and employment and thereby reduce the incidence of poverty, yet they are less in placed in the poorest areas of the region. Instead, economic development remains concerted in key cities and its corridor which influence the state of poverty in nearby localities while leaving the rest of the region as an entirely agricultural-based economy susceptible to unfavorable climatic condition and topographic limitation for agricultural production. The bias of the national government in providing annual fiscal support for local development to better-off cities further aggravates the inequality on the level of development and consequently, the level of poverty across localities. All of these findings suggest that geography and public policy have a strong impact on the condition of poverty. The physical/environmental condition and facets of public policies, indeed, matter in understanding and more importantly, in fighting the prevalence of poverty.

## 6.2 Implications for further research

Although the study tried to explore the spatial patterns of poverty, it is worthwhile to examine the spatio-temporal patterns to find out whether the distribution of poverty is the same across time and space. But such task requires more poverty data at disaggregated level which is not available at this point especially in the Philippines. While the study tried to address the issue of the possible causes explaining the spatial variations in poverty condition, there is a need to examine further the spatial processes, mechanisms and dynamics at a smaller geographical level, such as a city/municipality or a *barangay*. Moreover, the study further needs to address the difference between urban versus rural poverty and the linkages between the two. The study also poses methodological challenges known as Modifiable Areal Unit Problem (MAUP), which is a problem arising from the imposition of artificial units of spatial reporting on continuous geographical phenomena. In this case, administrative boundary was used to extract environmental characteristics which are continuous phenomena and make these as discreet variables in order to allow regression with poverty incidence. This issue needs to be kept in mind when socio-economic and environmental data sets are combined as attempted in this study. This matter can probably be addressed by "pixelizing poverty," that is, analyzing poverty at the pixel level, which remains as one of the challenges in poverty analysis today.

# Acknowledgements

Finishing my study here in Japan would not have been possible without the support and help from a great number of people who deserve special mention.

First of all, I would like to express my sincere gratitude to my adviser, Dr. Yuji Murayama, for being very supportive to me on my research. I really appreciate his concern for me especially in giving sound advice and clear direction on my study. His doors are always open to me and to all of us in the laboratory anytime. He can always be reached out even if he is abroad. He is more than just an adviser but a father and mentor who "always care for his children." Special thanks also to Dr. Takehiro Morimoto for his support and concern not only with my thesis but also on our field and GIS laboratory work. I truly learned new GIS skills and techniques under his tutelage.

I gratefully acknowledge the Japanese Government for giving me a chance to study in Japan under the *Monbukagakusho* scholarship. Without this funding support, my graduate studies in the University of Tsukuba would never be possible.

I am highly indebted to Mr. Anthony P. Ferrer, Vice President for Operations of Cybersoft Integrated Geoinformatics, Inc., a private mapping company operating in the Philippines for providing me most of the spatial data for Bicol Region. I am truly grateful for him for his willingness to give me the shapefiles for free after a couple of business talks and formalities. I would also like to thank Ms. Juliet Manguerra of the Bureau of Soils and Water Management for helping me acquire the soil map data for Bicol. I particularly grateful also to the staff of the National Statistical Coordination Board in Legaspi City for their untiring effort to provide me most of the socio-economic and poverty data that I need for this research.. Special thanks also to the staff of the Department of Land Reform in Bicol as well as to the staff of the Regional Operations Coordination Services of the Department of Budget and Management for giving me access to data on agrarian reform and IRA.

I warmly thank all my laboratory mates, especially to Thapa-san, Ngigi-san, Mizutani-san, and Yalong-san for the fruitful discussion and suggestions for improvement on my research.

Thanks to all my Filipino friends here in Japan – Turda Family, Romar and Raquel, Benja and Yuka, John, Ate Fe, Ate Buena, Wondy and Jojo – and the rest of the members of the Association of Filipino Scholars in Tsukuba who have made my stay enjoyable and meaningful.

I would not forget to thank the members of Tsukuba International Christian Church, especially to Pastor Tad, Dora-san, Kumada-san, and Ate Au, for all their help and support in making my stay here in Japan just like a place away from home. I am really very blessed to meet them and though we come from different culture, we share Christian love and fellowship together.

My special gratitude is due to my parents, to Malet, and Apung Banang for their support and prayers. Finally, I want to thank my wife, Mau, for her untiring love and understanding. I feel strong to face new challenges because of her continuing support and encouragement.

For all the experiences I have had, for all the blessings in my life, for the successes I may have, I acknowledge that they are all from God. To God be the glory, honor and praise!

A great thanks to all!

# Bibliography

Akinyemi, F. O. 2006. Spatial data needs for poverty management. Paper presented at the GSDI-9 Conference. Santiago, Chile, November 6-10.
Link: http://gsdidocs.org/gsdiconf/GSDI-9/abstracts/TS54.1abstract.pdf

Albert, J. R. G. and Collado, P. M. 2004. Profile and determinants of poverty in the Philippines. Paper presented at the 9th National Convention on Statistics, Pasig City, Metro Manila, October 4-5.
Link: http://www.nscb.gov.ph/ncs/9thncs/papers/poverty_Profile.pdf

Amarasinghe, U., Samad M. and Anputhas, M. 2005. Spatial clustering of rural poverty and food insecurity in Sri Lanka. *Food Policy* 30: 493-509.

Balisacan, A. M. 2007. Why does poverty persist in the Philippines? facts, fancies and policies. SEARCA Agriculture and Development Discussion Paper Series No. 2007-1. Southeast Asian Regional Center for Graduate Study and Research in Agriculture. Laguna, Philippines, March.
Link: http://web.searca.org/files/DPS_why_poverty_persist.pdf

Benson, T., Chamberlin, J. and Rhinehart, I. 2005. An investigation of the spatial determinants of the local prevalence of poverty in rural Malawi. *Food Policy* 30 (5-6): 532-550.

Biau, G., Zorita, E., Von Storch, H. and Wackernagel, H. 1999. Estimation of precipitation by kriging in the EOF space of the sea level pressure field. *Journal of Climate* 12: 1070-1085.

Bigman, D. and Fofack, H. 2000. Geographical Targeting for Poverty Alleviation: Methodology and Applications. Washington D.C.: The World Bank.
Link:http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2000/11/04/000094946_00102111465045/Rendered/PDF/multi_page.pdf

Bigman, D. and Srinivasan, P. V. 2002. Geographical targeting of poverty alleviation programs: methodology and applications in rural India. *Journal of Policy Modeling* 24: 237-255.

Coudouel, A., Hentschel, J. S. and Wodon, Q. T. 2002. Poverty measurement and analysis in the PRSP sourcebook. Washington D.C.: The World Bank.
Link: http://poverty2.forumone.com/files/5467_chap1.pdf

Crump, J. R., 1997. Teaching the political geography of poverty. *Journal of Geography* 96: 98-104.

Davis, B. 2003. Choosing a method for poverty mapping. Rome: Food and Agriculture Organizations of the United Nations.
Link: http://www.fao.org/docrep/005/Y4597E/Y4597E00.HTM

Deichmann, U. 1999. Geographic aspects of poverty. Prepared for the website on Poverty and Inequality and Socioeconomic Performance. The World Bank.
Link: http://povlibrary.worldbank.org/files/5319_povmap.pdf

Domingo, E. V. 2003. Poverty mapping in the Philippines. Paper presented during the UNESCAP Ad Hoc Expert Group Meeting on Poverty Mapping and Monitoring Using Information Technology. Bangkok, Thailand. August 18-20.
Link: http://www.unescap.org/pdd/calendar/pov_map/index.asp

Fischer, G., Van Velthuizen, H., Nachtergaele, F. and Medow, S. 2000. Global Agro-ecological Zones. Rome, Italy and Laxenburg, Austria: Food and Agriculture Organization of the United Nations and International Institute for Applied Systems Analysis.
Link: http://www.iiasa.ac.at/Research/LUC/GAEZ/index.htm

Fujii, T. 2004. Commune level estimation of poverty measures and its application in Cambodia. Research Paper No. 2004/48. Helsinki, Finland: United National University – World Institute for Development Economics Research.
Link: www.wider.unu.edu/publications/rps/rps2004/rp2004-048.pdf

Glasmeier, A. 2002. One Nation, pulling apart: the basis of persistent poverty in the USA. *Progress in Human Geography* 26: 155-173.

Henninger, N. H. 1998. Mapping and geographic analysis of human welfare and poverty – review and assessment. Washington, D.C.: World Resources Institute, April.
Link: http://www.povertymap.net/publications/doc/henninger/

Henninger, N. H. and Snel, M. 2002. Where are the poor? Experiences with the development and use of poverty maps. Washington D.C. and Arendal, Norway: World Resources Institute and United Nations Environment Programme GRID-Arendal.
Link: http://www.povertymap.net/publications/wherearethepoor/

Hentschel, J., Lanjouw, J., Lanjouw, P. and Poggi, J. 2000. Combining census and survey data to trace the spatial dimensions of poverty: A case study of Ecuador. *The World Bank Economic Review* 12: 146-65.

Huddleston, B., Ataman, E., and d'Ostiani, L. F. 2003. Towards GIS-based analysis of mountain environments and populations. Environmental and Natural Resources Working Paper No. 10. Rome: Food and Agriculture Organization of the United Nations.
Link:http://www.povertymap.net/publications/doc/Mountain20Env20Pop202920Apr200320s.pdf

Hyman, G., Larrea, C. and Farrow, A. 2005. Methods, results and policy implications of poverty and food security mapping assessments. *Food Policy* 30: 453-460.

Jalan, J. and Ravallion, M. 1997. Spatial poverty traps? World Bank Policy Research Working Paper 1862. October.
Link: http://ssrn.com/abstract=597203

Jarvis A., Reuter, H. I., Nelson, A., Guevara, E. 2006. Hole-filled seamless SRTM data V3, International Centre for Tropical Agriculture (CIAT).
Link: http://srtm.csi.cgiar.org.

Kainuma, E. 2003. Geographical study on regional differential of family income in the Philippines. University of Tsukuba. Doctoral Dissertation. January.

Kam, S. P., Hossain, M., Bose, M. L. and Villano, L. S. 2005. Spatial patterns of rural poverty and their relationship with welfare-influencing factors in Bangladesh. *Food Policy* 30: 551-567.

Kristjanson, P., Radeny, M. Baltenweck, I., Ogutu, J. and Notenbaert, A. 2005. Livelihood mapping and poverty correlates at a meso-level in Kenya. *Food Policy* 30 (5-6): 568-583.

Lanjouw, P. 2004. The geography of poverty in Morocco: Micro-level estimates of poverty and inequality from combined census and household survey data. The World Bank. February 24.
Link:siteresources.worldbank.org/INTPGI/Resources/342674-1092157888460/Lanjouw.GeographyPovertyMorocco.pdf

Legg, C., Kormawa, P., Maziya-Dixon, B., Okechukwu, R., Ofodile, S. and Alabi, T. 2005. Report on mapping livelihoods and nutrition in Nigeria using data from the National Rural Livelihoods Survey and the National Food Consumption and Nutrition Survey. International Institute for Tropical Agriculture. Ibadan, Nigeria.
Link: http://gisweb.ciat.cgiar.org/povertymapping/Nigeria.pdf

Milbourne, P. 2004. The local geographies of poverty: a rural case-study. *Geoforum* 35: 559-575.

Minot, N., Baulch, B. 2005. Spatial patterns of poverty in Vietnam and their implications for policy. *Food Policy* 30: 461-475.

Minot, N., Baulch, B., Epprecht, M. 2003. Poverty Mapping and Inequality in Vietnam: Spatial Patterns and Geographic determinants. International Food Policy Research Institute and Institute of Development Studies, Hanoi, Vietnam.
Link: http://www.ifpri.org/divs/mtid/dr/dr200312mapping.htm

Mistiaen J. A., Özler, B. Razafimanantena, T. and Razafindravonona, J. 2002. Putting welfare on the map in Madagascar. Africa Region Working Paper Series 34. The World Bank, Washington D.C., August.
Link: http://www.worldbank.org/afr/wps/wp34.pdf

NASA Landsat Program. 2003, Landsat ETM+ United States Geological Survey, Sioux Falls.

National Statistical Coordination Board. 2005. Local estimation of poverty in the Philippines. Manila: National Statistical Coordination Board and World Bank. November. Link:http://siteresources.worldbank.org/INTPGI/Resources/342674-1092157888460/Local_Estimation_of_Poverty_Philippines.pdf

National Statistical Coordination Board. 2004. Regional social and economic trend 2004 Bicol. National Statistical Coordination Board. Manila.

Petrucci, A., Salvati, N., and Seghieri, C. 2003. The application of a spatial regression model to the analysis and mapping of poverty. Rome: Food and Agriculture Organization of the United Nations.
Link: http://www.fao.org/DOCREP/006/Y4841E/Y4841E00.HTM

Powell, M., Boyne, G. and Ashworth R. 2001. Towards a geography of people poverty and place poverty. *Policy and politics* 29: 243-258.

Ravallion, M. and Wodon, Q. T. 1997. Poor areas, or only poor people? World Bank Policy Research Working Paper No. 1798.
Link:http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/1997/07/01/000009265_3980513111717/Rendered/PDF/multi_page.pdf

Republic of the Philippines. General Appropriations Act of 2000. Republic Act 8760.

Republic of the Philippines. Local Government Code of 1991. Republic Act 7160.

Republic of the Philippines. National Statistics Office. CY 2000 Family Income and Expenditure Survey

Republic of the Philippines. National Statistics Office. CY 2000 Census of Population and Housing

Republic of the Philippines. Social Reform and Poverty Alleviation Act. Republic Act 8425

Reyes, C. M. and Valencia, L. E. 2004. Poverty Reduction Strategy and Poverty Monitoring: Philippine Case Study. Paper presented at the Regional Conference on Monitoring Poverty in Asia, Asian Development Bank, Manila. March 24 -26, Link:http://siteresources.worldbank.org/INTPAME/Resources/Country-studies/philippines_povmonitoring_casestudy.pdf

Sachs, J. D. and Warner, A. M. 1997. Sources of slow growth in African economies. *Journal of African Economies* 6: 335-376.

Snel, M. 2004. Poverty-Conservation Mapping Applications. IUCN World Conservation Congress, Bangkok, Thailand, November 2004.
Link: www.povertymap.net/publications/doc/iucn_2004/poverty-biodiversity.pdf

United Nations. 2000. UN Resolution No. 55/22. UN Declaration of the Millennium Development Goals. September 18.

United Nations Development Programme. 2003. Human Development Report 2003. Millennium Development Goals: A compact among Nations to end human poverty. New York: Oxford University Press.
Link: http://hdr.undp.org/en/reports/global/hdr2003/

United Nations. 1992. Second Report on the World Nutrition Situation. Committee on Coordination – Subcommittee on Nutrition, Vol. 1, Global and Regional Results Geneva: United Nations.
Link: http://www.unsystem.org/scn/archives/rwns02vol1/index.htm

University of Arizona. 1998. Arizona Master Gardener Manual. Cooperative Extension, College of Agriculture, University of Arizona.
Link: http://cals.arizona.edu/pubs/garden/mg/index.html

Vaughan, L., Clark, D. C., Sahbaz O. and Haklay, M. 2005. Space and exclusion: does urban morphology play a part in social deprivation? *Area* 37: 402-412.

World Bank. 2001. Philippines Poverty Assessment Volume 1: Main Report. Poverty Reduction and Economic Management Unit East Asia and Pacific Region, May 31. Link:http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2002/01/07/000094946_01121904064580/Rendered/PDF/multi0page.pdf

World Resources Institute. 2007. Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-being. World Resources Institute: Washington DC and Nairobi.
Link: http://www.wri.org/publication/natures-benefits-in-kenya

# Appendix

**Appendix 1: Correlation matrix for all of the variables used in multiple regression analysis**

| Variables | Incidence | Elevation | Slope | Soil | Rainfall | River | Road | Distance | Agrarian Reform | IRA | Pop. Growth |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Poverty incidence | 1 | | | | | | | | | | |
| Mean elevation | 0.106 | 1 | | | | | | | | | |
| Slope above 8% | 0.530* | 0.658* | 1 | | | | | | | | |
| Soil with constraint | 0.029 | 0.474* | 0.413* | 1 | | | | | | | |
| Mean annual rainfall | 0.024 | 0.265 | 0.135 | 0.556* | 1 | | | | | | |
| River mean density | -0.458* | -0.528* | -0.559* | -0.242 | -0.287** | 1 | | | | | |
| Road density mean | -0.746* | -0.322* | -0.56* | -0.195 | -0.300** | 0.670* | 1 | | | | |
| Distance to major cities | 0.582* | 0.204 | 0.481* | 0.304** | 0.357* | -0.305** | -0.512* | 1 | | | |
| Agrarian Reform accom. rate | -0.208 | 0.130 | 0 | 0.236 | 0.019 | 0.247 | 0.319** | -0.127 | 1 | | |
| Percent of share in IRA | -0.530* | 0.073 | -0.052 | 0.135 | -0.023 | 0.137 | 0.379* | -0.199 | 0.372* | 1 | |
| Population growth rate | -0.460* | 0.024 | -0.244 | -0.096 | -0.096 | 0.212 | 0.255 | -0.457* | 0.268** | 0.128 | 1 |

*Significant at 0.01
**Significant at 0.05

**Appendix 2: CY 2000 total rainfall values by weather station**

| Station No. | Location | Latitude | Longitude | Rainfall (in mm) |
|---|---|---|---|---|
| PHI98444 | Legaspi City | 13.13333 | 123.7333 | 4,698 |
| PHI98446 | Virac Synop | 13.58333 | 124.2333 | 4,044.5 |
| PHI98447 | Virac Radar | 13.98333 | 124.3167 | 4,838.6 |
| PHI98543 | Masbate | 12.36667 | 123.6167 | 3,142.2 |
| PHI98546 | Catarman | 12.48333 | 124.6333 | 5,065.7 |
| PHI98427 | Tayabas | 14.03333 | 121.5833 | 4,033.8 |
| PHI98435 | Alabat | 14.01667 | 122.0167 | 4,031.1 |
| PHI98440 | Daet | 14.11667 | 122.9833 | 4,674.9 |
| PHI98434 | Infanta | 14.75 | 121.65 | 5,105.3 |
| PHI98536 | Romblon | 12.58333 | 122.2667 | 3,025 |
| HI98548 | Catbalogan | 11.78333 | 124.8833 | 4,075.9 |
| PHI98550 | Tacloban City | 11.23333 | 125.0333 | 3,508.4 |
| PHI98538 | Roxas City | 11.58333 | 122.75 | 2,910.5 |

*Source: Philippine Atmospheric, Geophysical and Astronomical Services Administration*

**Appendix 3: Twenty seven most intense typhoons of Bicol Region (1947 - 2004)**

| Name | Period of Occurrences | Highest Wind Speed Recorded (in km/hr.) | Distance from Naga City (in km.) |
|---|---|---|---|
| 1. STY SENING (Joan) | Oct. 11 - 15, 1970 | 275 | DIRECT HIT |
| 2. STY ROSING (Angela) | Oct. 30 - 04 Nov. 1995 | 260 | 40 - NORTH |
| 3. STY ANDING (Irma) | Nov. 21 - 27, 1981 | 260 | 30 - NE |
| 4. STY LOLENG (Babs) | Oct. 15 - 24, 1998 | 250 | 35 - NNE |
| 5. STY SISANG (Nina) | Nov. 23 - 27, 1987 | 240 | 30 - SW |
| 6. STY SALING (Dot) | Oct. 15 - 20, 1985 | 240 | 70 - NORTH |
| 7. STY HERMING (Betty) | Aug. 07 - 14, 1987 | 240 | 70 - SSW |
| 8. STY YAYANG (Vera) | Nov. 04 - 07, 1979 | 240 | 90 - NE |
| 9. TY HARRIET | Dec. 28, 1959 - 02 Jan. 1960 | 225 | DIRECT HIT |
| 10. TY TRIX | Oct. 16 - 23, 1952 | 215 | 22 - NORTH |
| 11. TY UNSANG (Ruby) | Oct. 21 - 26, 1988 | 215 | 100 - NE |
| 12. TY WARLING (Orchid) | Nov. 17 - 27, 1983 | 205 | 180 - NE |
| 13. TY WELMING (Emma) | Oct. 31 - 08 Nov. 1967 | 205 | 20 - SW |
| 14. STY YOLING (Patsy) | Nov. 17 - 20, 1970 | 200 | 90 - NORTH |
| 15. STY DINDO (Nida) | May 13 - 19, 2004 | 185 | 117 - ENE |
| 16. STY KADING (Rita) | Oct. 25 - 27, 1978 | 185 | 90 - NORTH |
| 17. TY HUANING (Ruby) | Jun. 22 - 02 Jul. 1976 | 185 | 70 - NE |
| 18. TY DINANG (Lee) | Dec. 23 - 28, 1981 | 175 | 60 - SOUTH |
| 19. TY YONING (Skip) | Nov. 03 - 12, 1988 | 175 | 150 - SW |
| 20. TY MONANG (Lola) | Dec. 02 - 07, 1993 | 170 | 35 - NORTH |
| 21. TY DIDANG (Olga) | May 12 - 27, 1976 | 150 | 200 - NORTH |
| 22. TY FRAN | Dec. 27, 1950 - 01 Jan. 1951 | 150 | 30 - NORTH |
| 23. TY JEAN | Dec. 22 - 29, 1947 | 150 | DIRECT HIT |
| 24. TY UNDING (Muifa) | Nov. 14 - 21, 2004 | 130 | 5,10 - EAST |
| 25. TY KONSING (Ora) | Jun. 23 - 25, 1972 | 130 | 20 - SW |
| 26. TY BEBENG (Vera) | Jul. 12 - 16, 1983 | 130 | 30 - SW |
| 27. TY SALING (Dan) | Oct. 06 - 13, 1989 | 120 | 15 - SW |

Note: The highlighted links on each name are individual tracks. All data are provided courtesy of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), except for the individual tracks which is provided by the Joint Typhoon Warning Center, Hawaii (JTWC) and Unisys' Weather Processor - Typhoon & Hurricane Data.

Legend:

STY - Super Typhoon
TY - Typhoon
TS - Tropical Storm
** - Undetermined/To Be Verified

Source: www.typhoon2000.ph