

**10<sup>th</sup> National Convention on Statistics (NCS)**  
EDSA Shangri-La Hotel  
October 1-2, 2007

**Multi-Scale and Multi-Temporal Poverty Mapping in The Manila Observatory**

by

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## **ABSTRACT**

As part of a proposed Poverty Alleviation Decision Support System (PADSS), forms, patterns and structures of poverty at various scales and years were analyzed through Remote Sensing and Geographic Information Systems (RS-GIS). Locational motivation behind informal settlements within MM and in Muntinlupa include vacant lots and easements, major transport routes, water bodies, sites for vegetable gardens and job attractors, like commercial and industrial areas and informal livelihood sources. Clustering around socio-economic attractors is evident from large and smaller pockets of slums.

National-scale and multi-temporal mapping of poverty indices were also undertaken by province. Results are indicative of movement or migration. This is also evident from metropolitan and city or municipal poverty change detection.

A useful application of RS-GIS is also land suitability mapping. Existing land use and cover, slope, water availability, distance to employment, development costs, natural hazards and risks influence the appropriateness of a site for a specific or multiple purpose, especially socialized housing. These suitability maps are important inputs to Comprehensive and Sustainable Land Use Plans (CSLUP), especially towards the better integration of the marginalized into the urban system. UPM IV, which studies informal livelihood hubs and clusters in Metro-Manila, is highly recommended as overlay to dynamic settlement patterns, including those of the poor.

## **I. Introduction**

Better targeting the beneficiaries of poverty programs can be addressed only if we know where the poor are. A map of poverty is important to have a better picture of where the poor settle. A priori, it is argued that the poor are generally mobile. Poverty, thus, needs to be tracked in terms of geography as well as over time.

Poverty mapping is not a new idea. It is defined as “the spatial representation and analysis of indicators of human well-being and poverty. It provides a systematic and analytical picture of poverty.” (HENNIGER AND SNEL, WRI/UNEP/GRID-Arendal 2002).

The Center for Environmental Geomatics in the Manila Observatory (CEG-MO) has undertaken studies on urban poverty morphology (UPM I to III), combining satellite remote sensing (RS) and geographic information systems (GIS). The morphological approach to the study of urban poverty considers forms, patterns and structures of informal settlements as manifested in space and across time.

Findings show that locational motivation behind the increase of slum and squatter settlements within MM and in Muntinlupa include the availability of vacant lots and easements, proximity to major transport routes, water bodies, sites for vegetable gardens and job attractors, such as commercial and industrial areas and informal livelihood sources. Clustering of informal settlements is evident in the formation of large and smaller pockets of slums.

On the other hand, strategic environmental assessment of urban poor land and housing demonstrated the importance of site suitability analyses applying RS-GIS prior to resettlement. Moreover, the study of the dynamics of the migration of informal settlements indicate densification as well as expansion around attractors.

National-scale poverty maps show the changing landscape of poverty using several indicators – poverty incidence, subsistence incidence, poverty gap index and severity index. The increase in poverty incidence in certain provinces (albeit slightly) may be due to the following:

- Some provinces lag in terms of economic growth and if a slowdown occurs they are more vulnerable than others.
- Geographic mobility of the poor over time.

Multi-scale poverty maps in tandem with other poverty measures would support poverty alleviation programs. A poverty map will guide policy-makers in distributing poverty alleviation funds.

Multi-scale poverty maps pose a wide range of options with respect to more efficient and cost effective solutions to socio-economic and environmental problems. If policy-makers can have a better picture of marginalization, then a more rational and integrated poverty alleviation strategy can be drafted and implemented.

## **II. Poverty Mapping: Methodology And Technical Aspects**

The poverty maps, generated by CEG-MO through the Urban Poverty Morphology Sub-Program (UPM), utilized satellite remote sensing (RS) and geographical information systems (GIS) technologies. RS means observation of objects and phenomena at a distance as by satellites. The data captured or collected by way of RS are in the form of imageries that may then be processed into meaningful spatial information. GIS is an

analytical tool, a computerized system and organizational activity that facilitate spatial analyses. Its components include hardware, software, data, people, organizations and institutional arrangements. These are necessary for collecting, storing, analyzing and disseminating spatial information. The outputs of RS are inputs to a GIS. These are technologies that have existed for decades. Since the mid-80s, these technologies have been used as socio-economic planning tools.

The poverty maps produced by CEG-MO under UPM are of national as well as metropolitan (Metro-Manila) and local scales, the latter being based on RS. The first step in generating the national poverty maps was to determine the administrative unit and the poverty indicators around which the maps will be based. For policy and decision-making purposes, indicative poverty maps based on regions and provinces prove very useful. The NAMRIA map of provincial boundaries was used as the base map. It was updated to include new provinces such as Kalinga and Apayao (which used to be a single province).

For national-scale poverty maps, statistical mapping that applied GIS enabled the creation of a spatial database of poverty indicators. Again, these are pegged to provinces for the years 1997 and 2000. This multi-temporal statistical mapping reflects changes that have occurred and trends by poverty measure during these two said years. Spatial information, in the geographic context, primarily deals with the distribution of objects and/or themes on the surface of the earth. In effect and to simplify a rather technical method, mapping involves linking statistics to polygons that represent spatial units like provinces.

Color codes were used to indicate poverty levels. The color shades darken as poverty levels worsen. These color-coded poverty levels are shown in the "legend" for each of the poverty maps. This kind of mapping is called choropleth.

### **III. Philippine Poverty – Comparing Statistics With Spatial Evidence**

#### The Poverty Picture Based on Official Statistics

The 2000 official poverty threshold measured by the National Statistics Office (NSO) is set at an average of PhP 14,615 for the urban area and PhP 11,908 for the rural area (see Table 1). The poverty threshold (or poverty line) is the average income required to meet the minimum food and non-food requirements of a family of five. Households with income below the poverty line are considered poor (i.e., poverty incidence).

Self-rated poverty measure, as practiced by the Social Weather Station (SWS), shows that the number of poor people has increased - From 55% in 1983 to 58% in 2002. Self-rating may be an interesting measure of poverty incidence. For the moment, however, this paper will focus only on official statistics.

TABLE 1. PHILIPPINES – AVERAGE POVERTY THRESHOLD, URBAN AND RURAL AREAS, 1997 AND 2000 (In Pesos)

Milieu	1997	2000
Urban Area	11,908.27	14,615.27
Rural Area	10,202.93	12,176.64

Source: National Statistical Coordination Board (NSCB)

Poverty incidence of families in the Philippines has worsened, albeit slightly, from 32% in 1997 to 34% in 2000 (see Table 2). Have the poor become poorer then? No they have not. This is based on the poverty gap index that compares a poor family's average income with the poverty threshold. The poverty severity index likewise remained almost unchanged in 2000 (4.6%) versus 1997 (4.3%). The poverty severity index considers income distribution among the poor, whereby the poorest are given the largest weight. Subsistence index measures the number of families who can hardly meet basic food needs. The incidence has slightly worsened in 2000 (17%) compared to 1997 (16%).

TABLE 2. PHILIPPINES – INCOME BASED POVERTY INDICATORS, 1997 AND 2000

Poverty Indicator	1997	2000
Poverty Incidence of Families	31.8%	33.7%
Poverty Gap Index	10.0%	10.7%
Poverty Severity Index	4.3%	4.6%
Subsistence Index of Families	16.2%	16.7%

Source: Family Income & Expenditures Survey (FIES), NSO, 1997, 2000; Reyes PIDS, 2002

Poverty incidence among the poorest regions of the country worsened in 2000 compared to 1997 (see Table 3, yellow shading) – i.e., ARMM, Bicol, CAR, Eastern Visayas, Western Mindanao. Only in Northern Mindanao was there a slight reduction to 46% in 2000

from 47% in 1997 (see Table 3, blue shading). This is despite the mobilization of PhP 7.0 billion of special poverty alleviation funds during the period 1997 to 2000 (see Table 4).

TABLE 3. PHILIPPINES– POVERTY INCIDENCE OF FAMILIES BY REGION, 1997 AND 2000 (In Percent)

Region	1997	2000
Philippines	31.8	33.7
NCR	6.4	8.7
1 - Ilocos	37.8	37.1
2 – Cagayan Valley	32.1	29.5
3 – Central Luzon	15.4	18.6
4 – Southern Tagalog	25.7	25.3
5 – Bicol	50.1	55.4
6 – Western Visayas	39.9	43.1
7 – Central Visayas	34.4	38.8
8 – Eastern Visayas	40.8	43.6
9 – Western Mindanao	40.1	46.6
10 – Northern Mindanao	47.0	45.7
11 – Southern Mindanao	38.2	40.0
12 – Central Mindanao	50.1	51.1
CAR	42.5	36.6
ARMM	57.3	66.0

Source: Family Income & Expenditures Survey (FIES), NSO, 1997, 2000; Reyes PIDS, 2002

TABLE 4. PHILIPPINES– SPECIAL POVERTY ALLEVIATION FUNDS  
(In Pesos Billion)

Name of Fund	Total Amount
Poverty Alleviation Fund 2 (1997)	2.0
Poverty Alleviation Fund 3 (1998)	2.5
Lingap Para Sa Mahihirap, LPM (2000)	2.5
Kapit Bisig Laban sa Kahirapan, KALAHI (2001)	-

Source: Medium-Term Philippine Development Plan (MTPDP) 2001-04; National Anti-Poverty Commission (NAPC); Reyes PIDS 2002

The Poverty Picture Based on Morphological Poverty Maps

Statistical data is the conventional method of presenting poverty levels in the Philippines. Poverty mapping based on footprints of informal settlements composed of shanties has greater potential to be appreciated by economists and policy-makers who are engaged in studying poverty and finding solutions to reduce its incidence and persistence. A poverty map is a graphical representation of statistical data gathered from the ground. Over time, a poverty map (e.g., based on poverty incidence) can illustrate the changing landscape of poverty incidence as a result of economic growth and poverty alleviation funds. It shows in visual form (at a glance) whether indeed economic growth is equitable and whether poverty alleviation funds were well-targeted.

In the Philippines, the Center for Environmental Geomatics of the Manila Observatory (CEG-MO) has initiated the creation of poverty maps at three scales: National, metropolitan (Metro-Manila) and local. Poverty mapping is central to CEG-MO's Urban Poverty Morphology Projects (UPM Phases I, II and III). The UPM projects were jointly undertaken by the Urban Research Consortium (URC) and CEG-MO. For poverty mapping of Metro-Manila, both entities cost-shared satellite data with the Foundation for the Philippine Environment (FPE), the United States Agency for International Development (USAID) and the National Mapping and Resources Information Authority (NAMRIA).

The UPM projects applied remote sensing (RS) and Geographical Information Systems (GIS) to determine poverty sites (national, Metro-Manila and Muntinlupa) and urban sprawl (Metro-Manila). For Metro-Manila, in particular, research was focused on analyzing the formation and growth of large and small pockets of informal settlements:

"The rate of increase is 1,462,892.57 sqm (1.46 sqkm) on the average per annum. In 4 years, population growth, at 0.625 persons per sqm, reached a total of about 3,657,231 or 914,308 persons per year. The latter is within the reasonable range of statistics... Detailed apportionment of growth... illustrates the rate of change per annum by cluster (1997-2000; [see maps of UPM III]). It is important to note that while there is generally growth, specific sites in areas of Manila (Clusters A and C), Quezon City (Clusters B and D) and Parañaque (Cluster G) manifest diminution of slum and squatter settlements..." (VICENTE et al, 2004, p. 42)

For UPM III, provincial level poverty maps indicate the external factors (experienced outside Metro-Manila) that may be influencing the migration and spatial distribution dynamics of informal settlers within Metro-Manila.

The national poverty picture over time is analyzed in this paper using four maps out of the eight poverty indicators that has been created. As shown in the legend for each map, poverty is worse as the color changes from lighter to darker shade.

**Poverty map 1 (PM1)** is based on **poverty incidence** – i.e., The number of families below the poverty threshold. It compares poverty incidence by province in 1997 and 2000. While indeed poverty incidence has been reduced in some provinces in the Philippines, it has worsened in others (see PM1). Poverty has not only worsened slightly in 2000 (34%) compared to 1997 (32%) but the poor may have also moved from one place to another. In Luzon, more provinces show poverty incidence rising (from light to dark) relative to areas where a reduction occurred (3 versus 1). Provinces where a distinctive increase in poverty incidence is observed are as follows: Abra, Pampanga and Zambales. In Pampanga, the worsening poverty incidence is natural disaster-related – i.e., The eruption of Mt. Pinatubo that destroyed vast tracts of agricultural land. Poverty reduction has been achieved significantly only in the Mt. Province. The Visayas region has been more successful in poverty alleviation than Luzon and Mindanao. More provinces experienced a reduction in poverty incidence (3 versus 1). An interesting observation is that while it has been reduced in Iloilo, poverty incidence worsened in Capiz. The possibility of the poor having moved cannot be discounted. Other provinces where poverty incidence dropped are: Negros Oriental and Eastern Samar. In Mindanao, more provinces experienced an increase in poverty incidence (5 versus 2). The number of poor families increased in the following: Zamboanga del Sur, Lanao del Norte, Maguindanao, Sultan Kudarat and Agusan del Sur. North Cotabato and Davao del Sur have less poor families in 2000 compared to 1997.

**Poverty map 2 (PM2)** depicts **subsistence incidence** by province comparing 1997 with 2000. Subsistence incidence indicates the proportion of poor families whose income is not enough to even meet basic food needs. In Luzon, more provinces managed to meet basic food needs over the period 1997 to 2000 (see PM2) (5 versus 1). Subsistence incidence dropped in Abra, Kalinga, Mt. Province, Oriental Mindoro and Albay. It worsened in Tarlac, indicating that more poor families in the said province experienced hunger. The Visayas and Mindanao are less successful than Luzon in reducing subsistence incidence. Subsistence incidence worsened in more provinces in the said regions (4 versus 1 in the Visayas; 6 versus 2 in Mindanao). In the Visayas, more poor families experienced hunger in Capiz, Negros Occidental, Northern and Western Samar. Note that while subsistence incidence was reduced in Antique, it worsened in Capiz. Again, could it be possible that the poor moved? In Leyte, less poor families experienced hunger in 2000 compared to 1997. In

Mindanao, subsistence incidence worsened in the following provinces: Zamboanga del Norte, Lanao del Norte, Maguindanao, Sultan Kudarat, Sarangani and Davao Oriental. The number of poor families experiencing hunger was reduced only in North Cotabato and Bukidnon.

**Poverty map 3 (PM3)** was based on the **poverty gap index** – An indicator of whether the poor have become poorer. At a glance, the maps show that the poverty gap has not worsened over the period 1997 to 2000 (see PM3). This means that the poor have not become poorer. A widening of the poverty gap in some provinces is balanced by a narrowing in other provinces. In Luzon, the provinces that have experienced a reduction in the poverty gap are Abra, Mt. Province, Ifugao and Pangasinan. But the gap widened in the following provinces: Occidental Mindoro, Oriental Mindoro and Catanduanes. In the Visayas, the number of provinces where the poverty gap widened (4) and where it narrowed are the same (4). The poverty gap narrowed in Iloilo and Antique but widened in Aklan and Capiz. Note that these are all adjacent provinces. Again, could it be possible that the poor moved? The same trend is likewise observed in the following provinces – A narrowing of the poverty gap in Northern and Eastern Samar and a widening in Bohol and Leyte. In Mindanao as in the Visayas, the number of provinces where the poverty gap widened (6) and where it narrowed are the same (6). The provinces that experienced a narrowing of the poverty gap are: Surigao del Norte, Surigao del Sur, Agusan del Sur, Davao Oriental, Bukidnon and North Cotabato. The provinces where the gap widened are: Zamboanga del Norte, Zamboanga del Sur, Lanao del Sur, Maguindanao, Sultan Kudarat and South Cotabato.

**Poverty map 4 (PM4)** depicts the **severity of poverty** by province. The poverty severity index is a measure of income distribution among the poor (i.e., those below the poverty threshold). The worse the income distribution, the more severe poverty is. At a glance, poverty did not become more severe over the period 1997 to 2000. In Luzon, poverty became less severe in the following provinces: Abra, Mt. Province, Ifugao, La Union, Marinduque, Albay and Sorsogon. In the Visayas, the poverty severity index was reduced in the following provinces: Northern and Eastern Samar, Southern Leyte, Iloilo and Antique. Note that while poverty became less severe in Iloilo and Antique, it became more severe in Capiz. Again, the possibility that the poor migrated cannot be outright discounted. In Mindanao, poverty became less severe in Surigao del Norte and Sur, Davao Oriental, Bukidnon and North Cotabato. The opposite is true in the following: Davao del Norte, Maguindanao, Sultan Kudarat, Zamboanga del Norte and Sur.

Ground verification by way of surveys is needed to further refine and more accurately localize the poverty maps that have been, thus far, generated. Two very important issues can be addressed as follows:

- Geographic mobility of the poor over time (origin to destination); and
- Awareness and impact of special poverty alleviation funds.

REYES in a 2002 PIDS (Philippine Institute for Development Studies) discussion paper noted that the Philippines “has achieved modest success in the area of poverty reduction and human development”. But the author also notes that:

- Poverty alleviation programs are not well targeted; and,
- Data to identify eligible beneficiaries are not readily available.

The above findings of REYES could be further strengthened with the use of mapping tools. Maps depicting the use and allocation of poverty alleviation funds can be compared against poverty maps. This will allow policy-makers to determine whether targets have been met or not as well as the factors contributing to cumulative and pervasive poverty. Note that the amount of special poverty alleviation funds budgeted during the period 1997 to 2000 total PhP 7.0 billion (see Table 4, Section 3). Data should be made available not only on the use of poverty alleviation funds by projects but more importantly their geographic allocation (i.e., By region, province, city/ municipality). A poverty alleviation funds map can be created for the period 1997 to 2000. A better analysis of the impact on poverty can be achieved when the allocation map is superimposed into the poverty maps presented in this paper. Again, this will allow policy-makers to assess whether the funds were efficiently used. For instance, were the programs well targeted? Funds should have gone and should be funneled to the poorest provinces.

There are lessons to be learned from the analysis of past poverty alleviation programs using mapping tools. These lessons will greatly help NAPC (National Anti-Poverty Commission) in implementing its poverty alleviation strategy and achieving a substantial impact. Furthermore, adopting mapping as an additional policy tool will result in greater transparency and accountability on the part of Government.

#### IV. Conclusions And Recommendations

Poverty incidence among the poorest regions of the country worsened in 2000 compared to 1997. The concerned regions are ARMM, Bicol, CAR, Eastern Visayas and Western Mindanao. Only in Northern Mindanao was there a slight reduction to 46% in 2000 from 47% in 1997. This is despite the mobilization of PhP 7.0 billion of special poverty alleviation funds during the period 1997 to 2000. A priori, the absence of multi-scale and multi-temporal poverty maps to guide policy and decision-makers on where to allocate funds results in less than efficient use of resources for effective poverty alleviation.

National-scale poverty maps presented in this paper show the changing landscape of poverty using several indicators – Poverty incidence, subsistence incidence, poverty gap index and severity index. The increase in poverty incidence in certain provinces (albeit slightly) may be due to the following:

- Some provinces lag in terms of economic growth and if a slowdown occurs they are more vulnerable than others.
- Geographic mobility of the poor over time.

ALBERT and COLLADO, in a paper “Profile and Determinants of Poverty in the Philippines” (National Statistics Office, NSO, 2004), recognized the importance of poverty mapping as a policy and decision-support tool. To quote: “Identifying where the poor are located is an important piece of information for an anti-poverty program”.

Economists and policy-makers should not ignore the importance of poverty maps in tandem with other poverty measures to support poverty alleviation programs. A poverty map will guide policy and decision-makers in distributing special poverty alleviation funds. Note that in negotiating the poverty landscape without a map, one can easily lose one’s way. The Government may run around in circles and that would prove to be a waste.

There are other areas where poverty maps are useful. These can be correlated and/or overlaid with maps indicating areas where climate/ weather-related, geophysical and ecological hazards hit the country. This is an important undertaking, especially since the Philippines is very vulnerable and at high risk to natural disasters. A link between poverty and natural disasters can, thus, be demonstrated. (see://<http://www.observatory.ph/vm>)

Maps may be generated in order to reflect vulnerable areas or hotspots, showing corresponding degrees of susceptibility to different hazards as well as the risk or losses arising from them. This will help the country prepare for frequent disasters and prioritize the allocation of resources to adapt to adversities or unfavorable conditions and/ or mitigate losses. (see://<http://www.observatory.ph/vm>)

Maps may link calamity fund distribution, occurrence of natural disasters, agriculture dependency, gross value added in services, industries and agriculture, fisheries and forestry, likelihood and experience of crop damage as well as poverty incidence.

Maps reflect spatio-temporal statistics. They pose a wide range of options with respect to more efficient and cost-effective solutions to socio-economic and environmental problems. If policy and decision-makers can have a better picture of marginalization, then a more rational and integrated poverty alleviation strategy can be drafted and implemented.

## Acknowledgements

- Arch. Bayani V. Paz, Jr., Chairman and CEO, BVP Digital Quest, Inc.
- Department of Environment and Natural Resources (DENR)
- Ford Foundation
- Foundation for the Philippine Environment (FPE)
- Luis A. Yulo Foundation for Sustainable Development (LAYFSD)
- National Disaster Coordination Council, Office of Civil Defense (NDCC/ OCD)
- National Mapping and Resources Information Authority (NAMRIA)
- Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
- United States Agency for International Development (USAID)
- University of the Philippines Training Center for Applied Geodesy and Photogrammetry (UP-TCAGP)
- Urban Research Consortium (URC)

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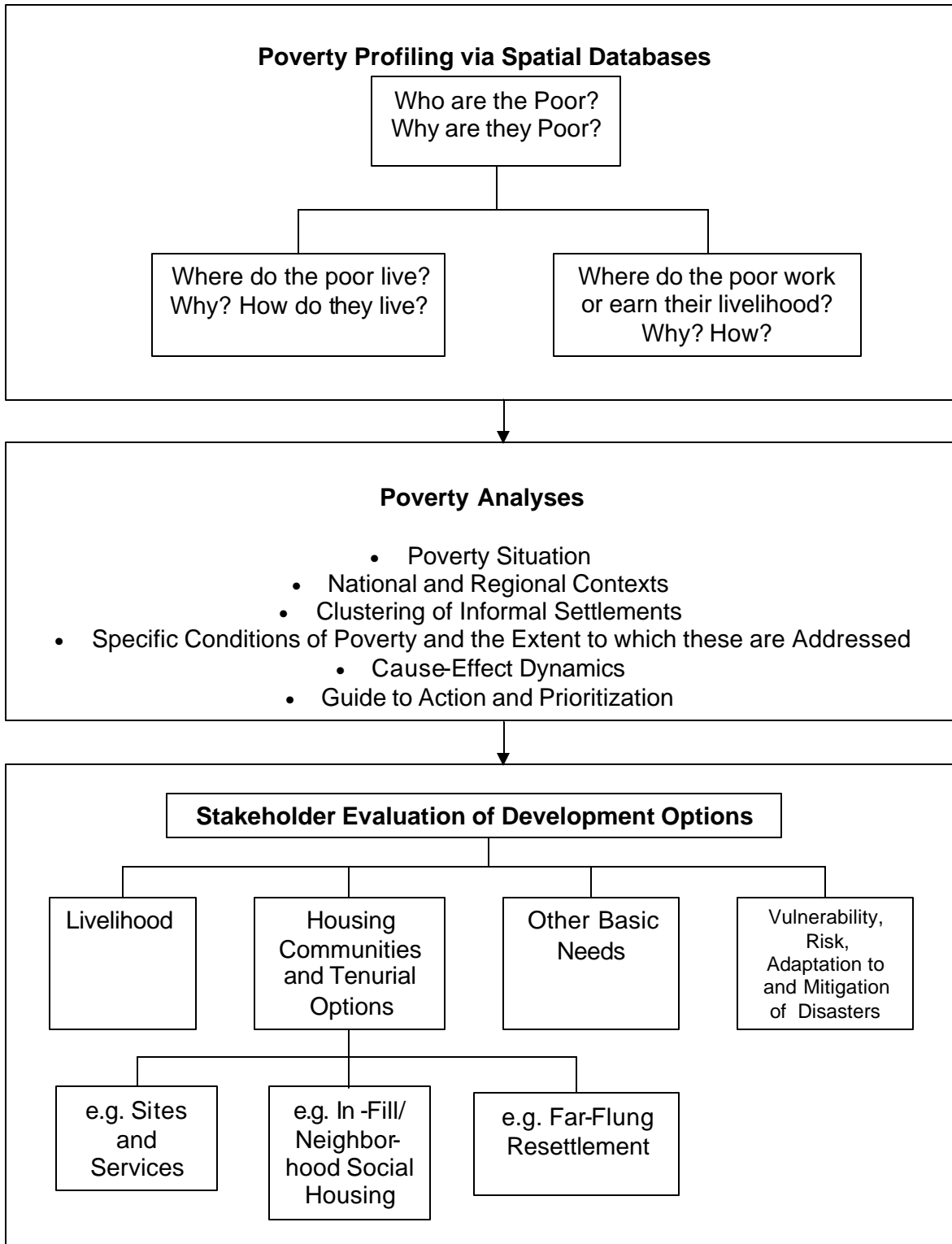


FIGURE 1. Poverty Alleviation Decision Support System

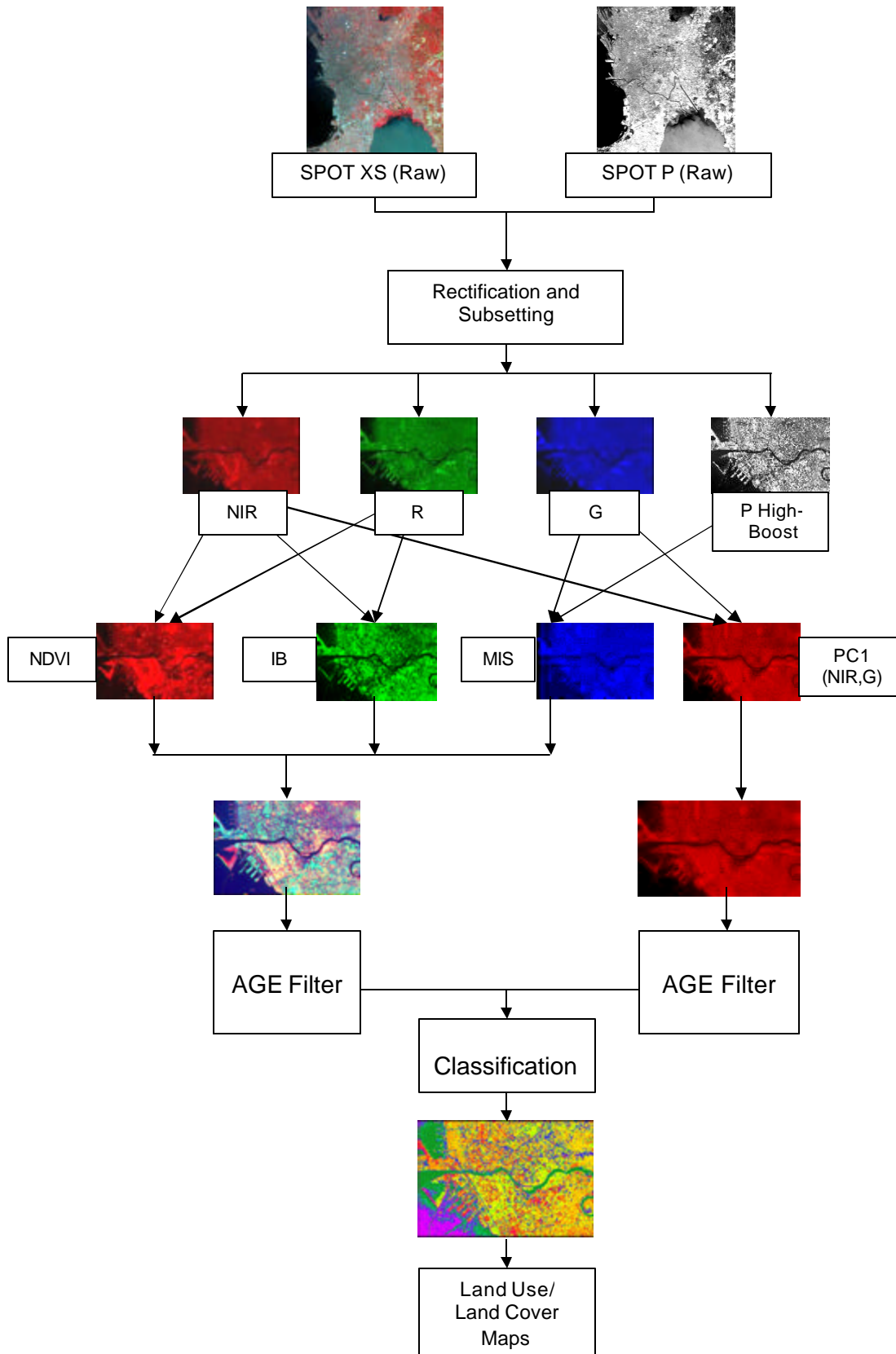


FIGURE 2. Methodology of UPM I

Methodology for UPM II

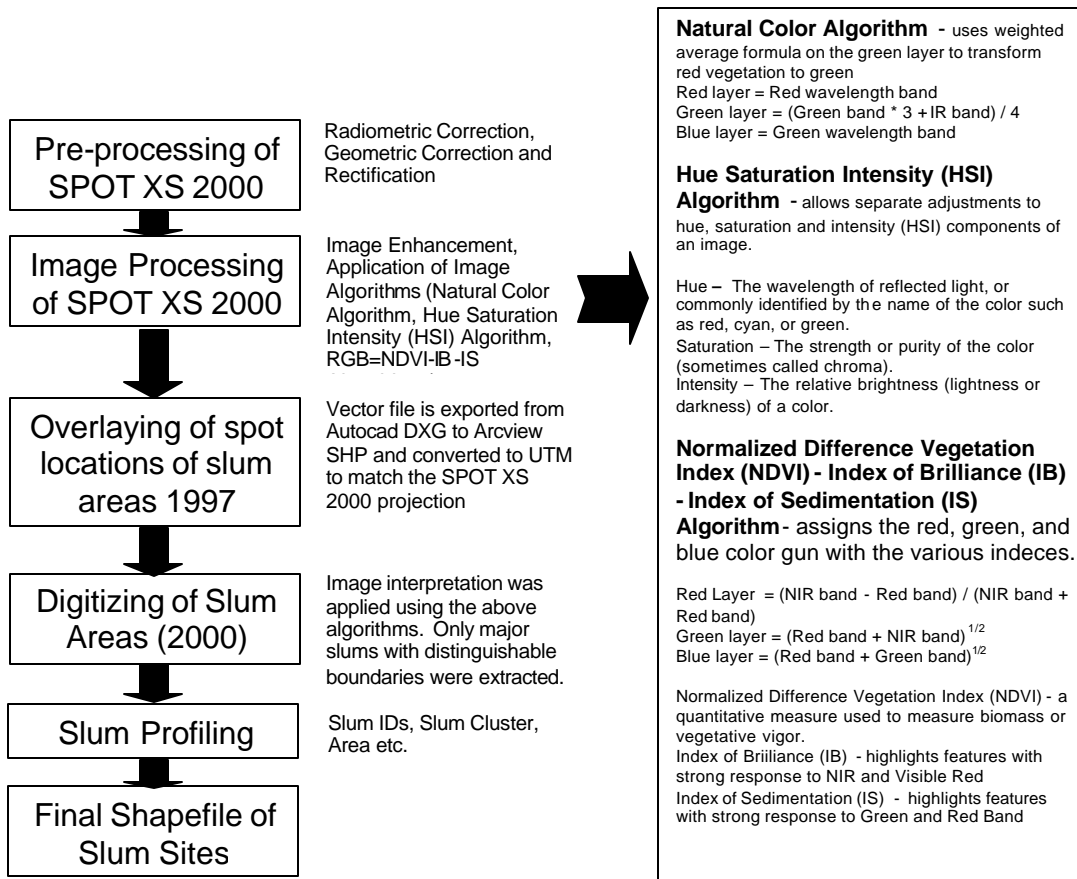


FIGURE 3. Methodology for UPM III



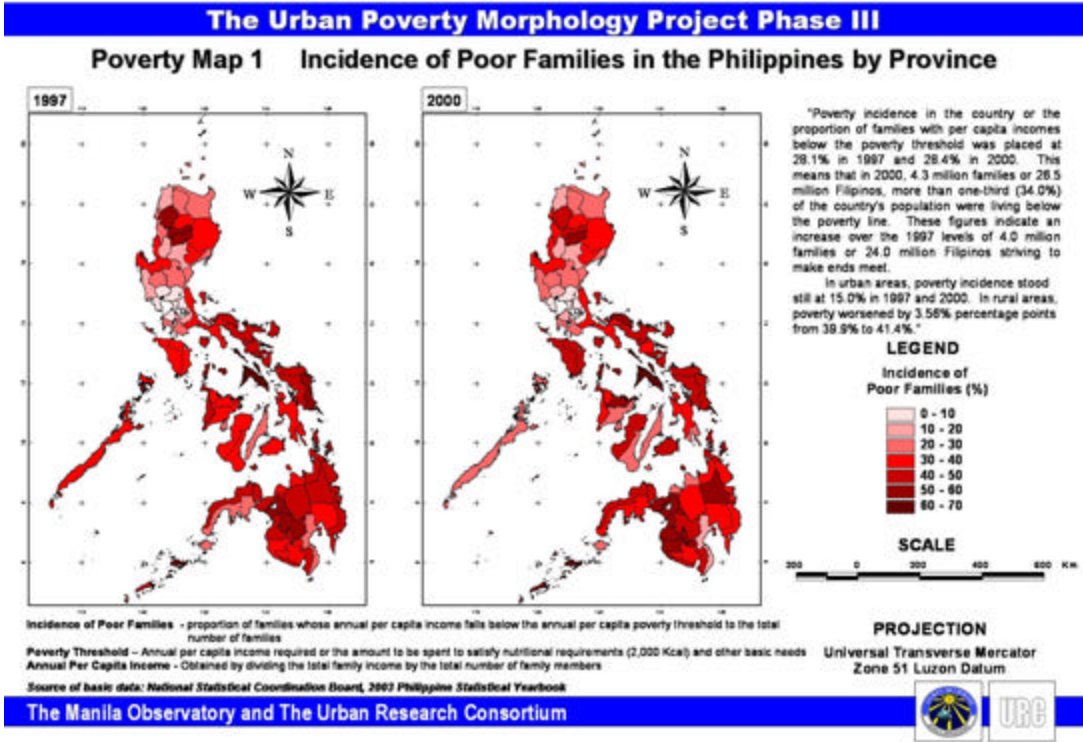


FIGURE 5. Poverty Map 1

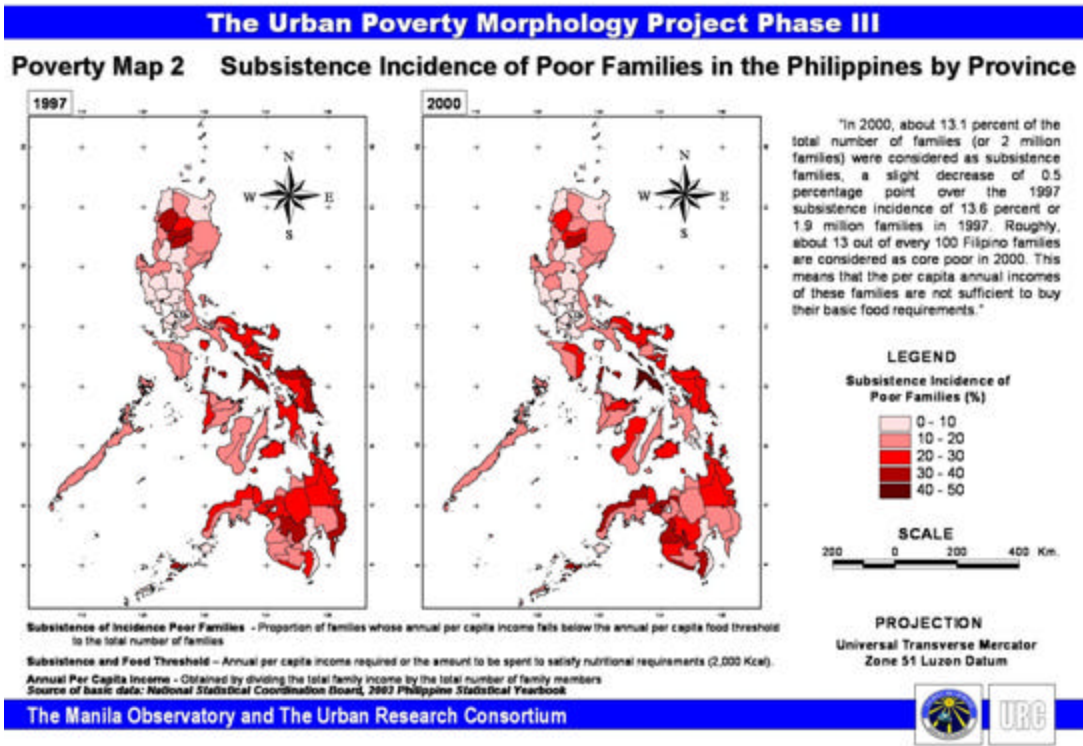
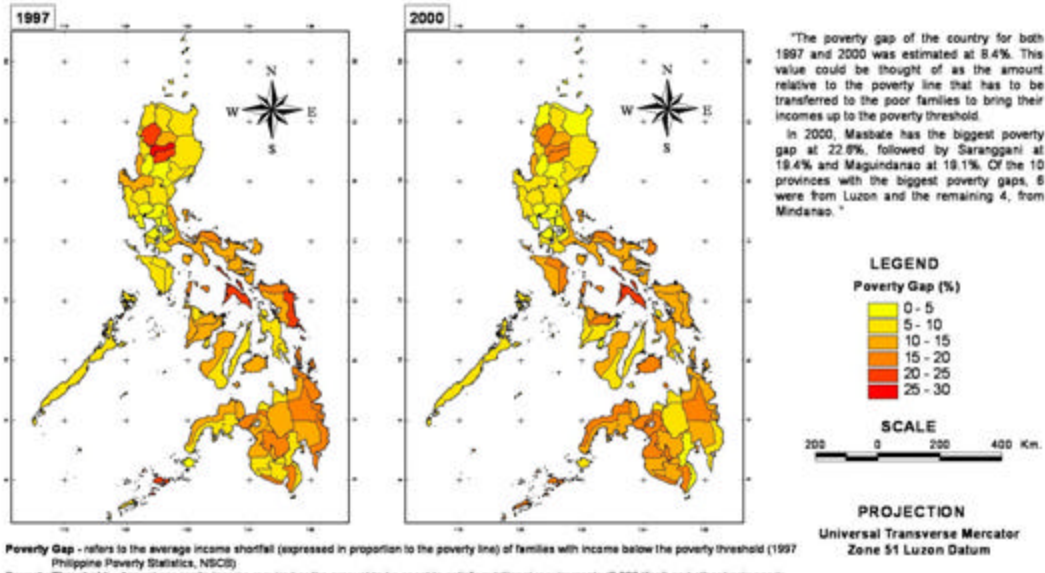


FIGURE 6. Poverty Map 2

**The Urban Poverty Morphology Project Phase III**

**Poverty Map 3 Poverty Gap by Provinces in the Philippines**



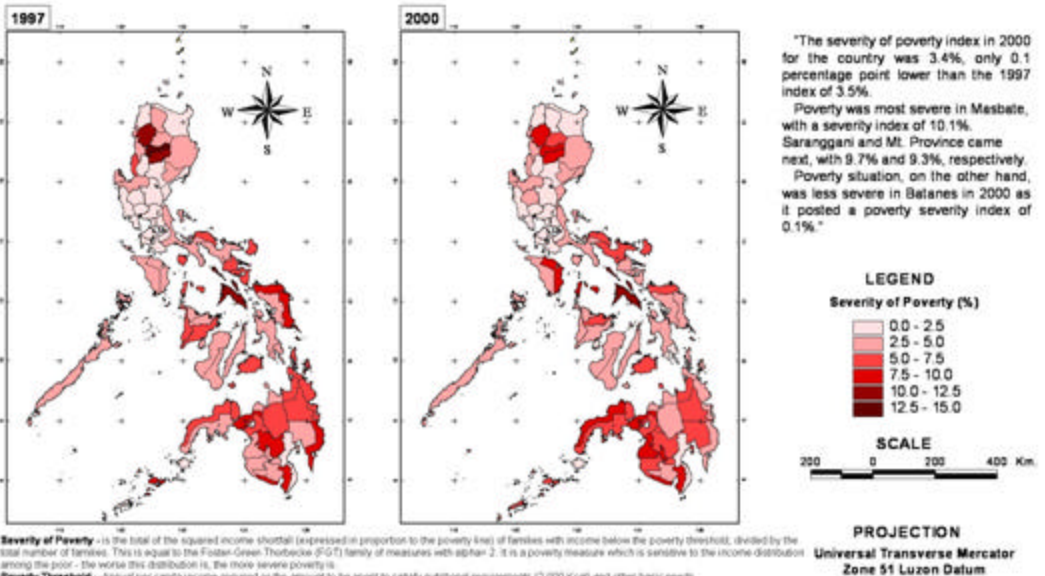
The Manila Observatory and The Urban Research Consortium



FIGURE 7. Poverty Map 3

**Phase III The Urban Poverty Morphology Project**

**Poverty Map 4 Severity of Poverty by Provinces in the Philippines**



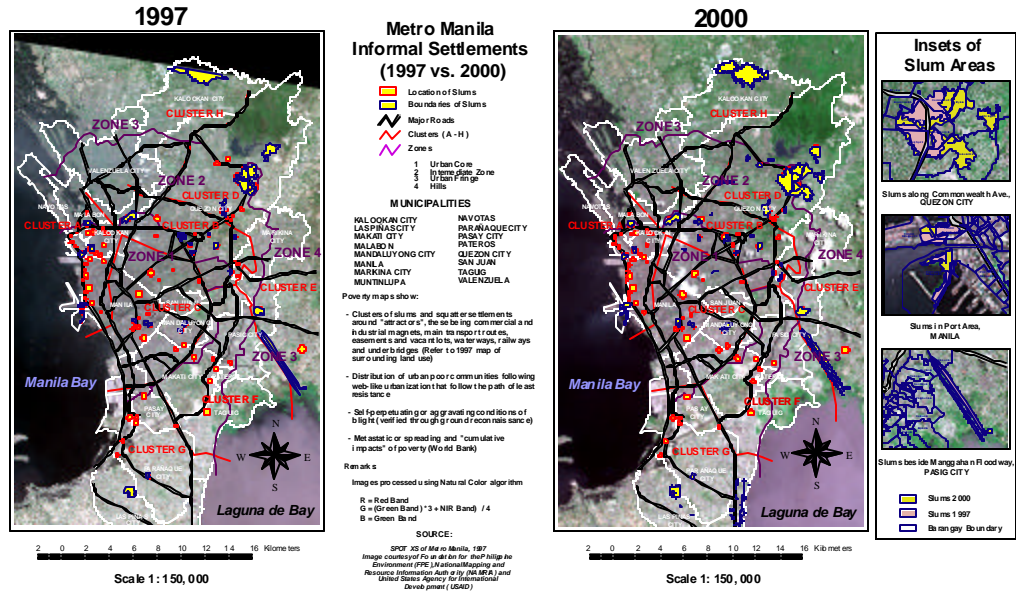
The Manila Observatory and The Urban Research Consortium



FIGURE 8. Poverty Map 4

# The Urban Poverty Morphology Project Phase III

Analysis of Migration and Spatial Distribution Dynamics of Informal Settlements in Metro Manila using Geomatics

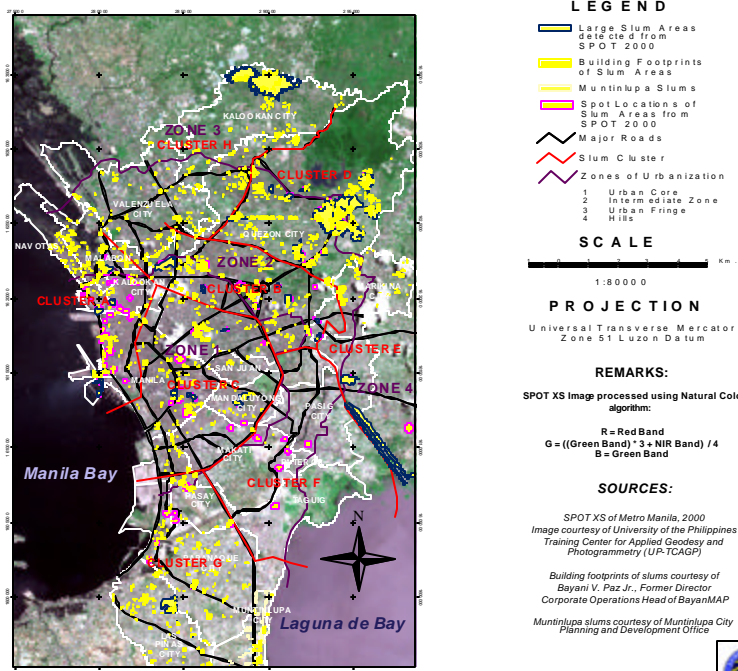


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FIGURE 9. UPM III 1997 and 2000, MM

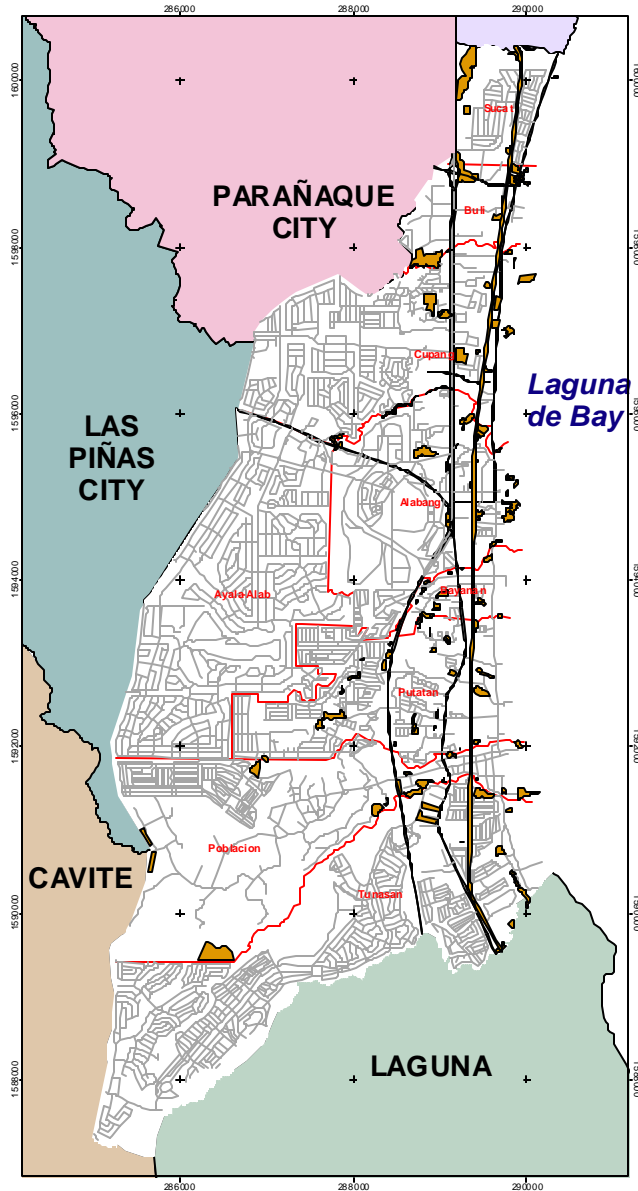
# The Urban Poverty Morphology Project Phase III

Aggregate Map of Informal Settlers in Metro Manila (2000)



The Manila Observatory and The Urban Research Consortium

FIGURE 10. UPM III Aggregate 2000, MM

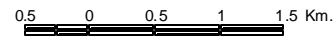


This map shows the slum areas in 9 barangays (Sucat, Buli, Cupang, Alabang, Ayala-Alabang, Bayanan, Putatan, Poblacion and Tunasan) of Muntinlupa City.

**LEGEND**

- Slum areas
- Roads
- Barangay Boundary

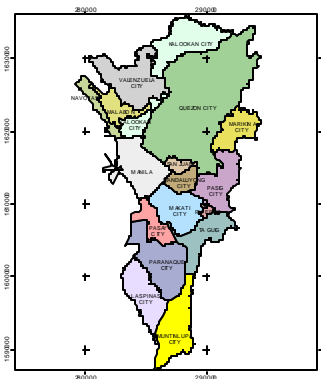
**SCALE**



**1:25000**

**PROJECTION**

Universal Transverse Mercator  
Zone 51 Luzon Datum



Source: Muntinlupa City Planning and Development Office, Department of Health (DOH) Metro Manila Roads Database

**FIGURE 11. Poverty Map of Muntinlupa**