CIAT

Centro Internacional de Agricultura Tropical
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Processing Social Indicators at Individual, Houshold level and their aggregation at different scales

Technical Report

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1 0 Introduction

This report is a description of the methodologies applied to process some household and social indicators and aggregate them at village (Aldea) level and municipal (Municipio) level The raw data used is adapted from the **National Census of Population and Housing of 1988** The data is inputted in an Oracle format at village level containing about **4255105 individuals and 891298 households** The methodology[1] applied to process the household indicators is closely related to the one applied in Bolivia (Republica de Bolivia 1995) Also other indicators processed are related with demographic and educational information presented in the working paper for GIS Unit (Ovana 1997) In addition indicators of child mortality and the percentage of female-headed households by village are processed to derive other poverty indicators (UNEP/GRID 1997, World Bank, 1994 and Coulombe 1996) The report also compares village codes and population figures using official publications from the Government of Honduras (Direccion General de Estadistica y Censos 1991 and Jimenez 1997) Before doing the graphic output of the indicators a comparison between the village codes from the Oracle aggregation and the Arc/Info coverage is done in order to identify villages without census information We do emphasize to the reader that the objective is not to make an in-depth study of Honduras But to provide a framework for using census data to understand spatial complexities of poverty and its characterization at micro-level in order to support the next phase of the poverty research project which involves studying the connection between poverty and natural resources degradation

[1] The Bolivian approach is modified after a cross checking and an evaluation effort of the resulting indicators by some adjustments and standardization of some of the norms to suit the Honduran context

2 0 Methodology

2 1 Household Indicators

2 1 1 Definition of Individual Indicators at household level

This methodology involves scoring all the variables with different weightings at household level First each variable at household level is given score of x_j The worst situation is given a value of **0** Second for each of these variables a minimum norm of satisfaction x^* is allocated It is important to mention that, this norm can be used flexibly taking into account recommendations from other main stakeholders at micro-level who possess good knowledge of the villages to further sharpen these results Nonetheless to define these norms examining the variable value frequency uses some universal standard In this way an indicator of degree of success represented by Ix_j is processed as follows

$$Ix_j = x_j / x^*$$

Where

x_j - Value of the observed variable

Ix_j - Indicator of success

x^* - Value of the minimal norm of satisfaction

Note that the range of values taken by the indicator depends on the number of options proposed by the census questionnaire and the value of that norm Third for each variable, an index of lack represented by cx_j is processed as follows

$$cx_j = 1 - Ix_j$$

cx_j – Indicator of lack for the household j

The values taken by this indicator are in the range from **–1** to **+ 1**

Where **–1** corresponds to the **best situation** and **1** the **worst 0** indicates that the **norm** (x^*) is **satisfied**

2 1 2 Scale adjustments applied for some indicators

When the indicator of lack is greater than 1 or lower than –1 a scale adjustment is applied to maintain the values within the range of –1 from +1 This is applied to derive the household educational index and the household size index (see also section 3 3 2)

In these cases the following adjustments are made

For $\min(cx_j) <= cx_j <= 0$

$cx_j = cx_j / \min(cx_j)$

For $0 < cx_j <= \max(cx_j)$

$cx_j' = cx_j / \max(cx_j)$

These scale adjustments are not applied to the Bolivian example For the Bolivian method only the values greater than 1 or lower than –1 have been modified The adjustments are implemented for this Honduran study because of the need to have completeness and coherence in the processing of poverty indicators For example in the case of the educational variable at household level the index cx_j is first processed at individual level and then aggregated at household level as explained below

2 1 3 Composite indicators

In order to derive composite indicators the processed indicators of lack and intensity of poverty are combined together using a mathematical formula as given below There are represented by NBI_3 and NBI_4 reflecting the level of non-satisfaction of these processed indexes

$$NBI\_3_j = (CV_j + CSIB_j + CIA_j) / 3$$

$$NBI\_4_j = (CV_j + CSIB_j + CIA_j + RE_j) / 4$$

NBI_3 and NBI_4 provide a measure of the intensity of poverty in relation to the norm chosen The values taken by these two indicators are in the range between –1 and +1 For each individual indicator the same weight is applied In addition details are provided below on how the two composite indexes are combined from several indicators of household size household quality, household shelter quality basic services energy supply education and other non land assets that were surveyed in the Population Census of 1988

$\mathbf{CV_j}$ is derived from the size of household represented by $\mathbf{CEV_j}$ (see annex) and quality of household represented by $\mathbf{CMV_j}$ It is processed as follows

$$\mathbf{CV_j = 1/2(CMV_j + CEV_j)}$$

$\mathbf{CMV_j}$ consists of the indicator of lack of wall quality ($\mathbf{cm_j}$) the indicator of lack of roof quality ($\mathbf{ct_j}$) and the indicator of floor quality ($\mathbf{cp_j}$) It is given by the formula below

$$\mathbf{CMV_j = (cp_j + cm_j + ct_j) / 3}$$

$\mathbf{CSIB_j}$ consists of the indicator of lack of basics services ($\mathbf{CSB_j}$) and the indicator of lack of energy supply ($\mathbf{CE_j}$) It is given by the formula below

$$\mathbf{CSIB_j = (CSB_j + CE_j) / 2}$$

$\mathbf{CSB_j}$ consists of the indicator of lack of water supply ($\mathbf{cag_j}$) installation ($\mathbf{ctu_j}$), and the indicator of lack of latrines supply ($\mathbf{csa_j}$) It is given by the formula below

$$CSB_j = (cag_j + ctu_j + csa_j) / 3$$

In the context of Honduras the indicator of lack of water supplies (cag_j), installation (ctu_j) and the indicator of lack of latrines supply into one indicator (csa_j) is weighted equally CE_j is derived from the indicator of lack of light supply (cal_j) and the indicator of lack of combustible (cco_j)

$$CE_j = (cal_j + cco_j) / 2$$

RE_j is the indicator of lack of education by household (see annex for more details) The indicator of success for the individual (i) in the household (j) represented by ane_{ij} is processed as follows

$$ane_{ij} = (ap_{ij} + as_{ij}) * al_{ij} / (ap^* + as^*)$$

Where

ap_{ij} – number of years of school

as_{ij} – school attendance as a function of the age

al_{ij} – literacy indicator

ap^* - Norm for the number of years of school as a function of the age

as^* - Norm for the school attendance as a function of the age

To derive the indicator of lack of education at individual level (re_{ij}) is processed as follows

$$re_{ij} = 1 - ane_{ij}$$

Note that the indicator of lack of education at household level is considered as an average of the values taken by $\mathbf{re_{ij}}$ It is given by the formula below

$$\mathbf{RE_j = (\ re_{ij}\ ) / m_j}$$

Where

$\mathbf{m_j}$ is the number of person in the household **j**

i is the code number for the each person who is living in the household **j**

$\mathbf{CIA_j}$ is the indicator of lack of non-land assets derived from three indicators These are lack of surveyed assets ($\mathbf{CBA_j}$), the lack of means of communication ($\mathbf{CCA_j}$) and the lack of means of transport ($\mathbf{CTA_j}$)

$$\mathbf{CIA_j = 0\ 25^{*}\ CBA_j\ + 0\ 4^{*}\ CTA_j\ + 0\ 35^{*}\ CCA_j}$$

$\mathbf{CBA_j}$ consists of the lack of surveyed assets calculated from the indicator of lack sew machine ($\mathbf{cm\_coser_j}$), fridge ($\mathbf{crefrigerador_j}$) and stove ($\mathbf{cestufa_j}$)

$$\mathbf{CBA_j = (cm\_coser_j + crefrigerador_j + cestufa_j\ ) / 3}$$

$\mathbf{CTA_j}$ consists of indicator of lack car ($\mathbf{cautomovil_j}$) lack of bicycle ($\mathbf{cbicicleta_j}$) and lack of motorcycle ($\mathbf{cmotocicleta_j}$)

$$\mathbf{CTA_j = (cautomovil_j + cmotocicleta_j + cbicicleta_j\ ) / 3}$$

$\mathbf{CCA_j}$ is composed of lack of means of communication (radio and television)

$$\mathbf{CCA_j = (\ cradio_j + ctelevisor_j) / 2}$$

Other individual indicators processed

The indicator of lack of water supply and water installation (CWAj) is processed to assess the water supply situation

$$CWA_j = (cal_j + cco_j) / 2$$

2 1 4 Approach used to characterize households by poverty level

By using the two derived composite indicators **(NBI_3j and NBI_4j)** 6 classes are defined according to the level of poverty (see Table 1 below)

Table 1 Household Poverty Classes in Honduras

Stratum Number	Definition	Minimum Value	Maximum Value
I	Extreme Poor	0 7	1
II	Poor	0 4	0 7
III	Moderate Poor	0 1	0 4
IV	Threshold of Poverty	-0 1	0 1
V	Above Threshold	-1	-0 1
VI	No Data		

Interpretation of Results

The strata II and I groups households with high poverty in term of lack of basics needs The stratum I deal with households whose basics needs have non-satisfaction average of 85% according with the norms defined above The stratum II deals with households whose basics needs have non-satisfaction average of 45% The stratum III deals with

households whose basics needs have non-satisfaction average of 25% The stratum IV deals with households whose basics needs have satisfaction average that corresponds to the norm defined The stratum V deals with households whose basics needs have satisfaction average of 55% over the norm It is pertinent to note that all the indicators of lack have been defined in the context of every value higher than 0 indicating lack of basic needs This would mean that every household whose indicators of lack are positive would normally be considered poor In order to be less restrictive a household is considered poor when its indicator of lack is higher than 0 1

2 1 5 Aggregating the Indicators at different scales

A Using different scales to aggregate indicators

Using the individual indicators and the derived indicators **(NBI_3 and NBI_4),** villages and municipals classification is conducted taking into account the percentage of households which do not have their basics needs satisfied In addition the percentage of households represented by **(P_6)** which are in the stratum VI (inconsistent values) is calculated using the formula below

P_6 = num_household_VI * 100 / Tot_household

Where

Num_household_VI is the number of households classified in the stratum VI

Tot_household is the total number of households by village or municipals

If **P_6** is higher than **50%** we consider the data as not valuable to continue the process of administrative unit classification But if **P_6** is lower than **50%** we apply the following formula

P_IND = (num_household_I + num_household_II) * 100 / Tot_household

Where

P_IND is the percentage of households that are considered extreme poor or poor within the administrative unit It measures the extent of poverty in terms of number of household for one indicator of lack (see the results in Table 2)

Num_household_I is the number of household classified in the stratum I

Num_household_II is the number of household classified in the stratum II

Table 2 Scale Characterization of Poverty

Poverty Class	Class Interpretation	Minimum Value of P_IND as a %	Maximum Value of P_IND as a %
1	Low	15 (0)[2]	35 (25)
2	Medium	35 (25)	55 (50)
3	Severe	55 (50)	75 (75)
4	Most Severe	75 (75)	100 (100)

B Villages classification according to the criteria of magnitude of poverty

By manipulating further the two derived composite indicators **(NBI_3 and NBI_4)**, two other indicators, which measure the magnitude of poverty have been processed At administrative unit the intensity of poverty has been measured by considering the values taken by NBI_3j NBI_4j (see section 2 1 3) and the number of persons living in each household affected in the strata I and II according with the criteria as explained in section 2 1 4

$$\mathbf{MAGP\_3} = ((m_j * NBI\_3_j)_{s=1} + (m_j * NBI\_3_j))_{s=2} / \mathbf{Tot\_household}$$

[2] Note that the ranges in brackets have been used for village scale only and the others used for municipal and departmental scale

$$MAGP\_4 = ((m_j * NBI\_4_j)_{s=1} + (m_j * NBI\_4_j))_{s=2} / Tot\_household$$

Where

m_j is the number of persons by household

NBI_3_j is the value of NBI_3 for the household j

NBI_4_j is the value of NBI_4 for the household j

s is the stratum number

These 2 indicators give the magnitude of poverty in terms of people and households in relation to the threshold levels of households In addition the values of **P_6, MAGP_3 and MAGP_4** are used for manipulating administrative units which are then classified as presented in Table 3

Table 3 Reclassification of Villages according to the Magnitude of Poverty

Poverty Class	Class Interpretation	Minimum Value of MAGP_3	Maximum Value of MAGP_3
1	Low	40 (0)[3]	120 (90)
2	Medium	120 (90)	200 (180)
3	Severe	200 (180)	280 (270)
4	Most Severe	280 (270)	360 (540)

[3] Note that the ranges in brackets have been used for village scale only and the others used for municipal and departmental scale

2 2 Other Socio-economic indicators

This section deals with the processing of other socio-economic indicators In order to ascertain the level of human capital development in Honduras other educational indicators are derived at village level (Ovana 1997) The sub sections below provide the indicators of adult literacy and illiteracy primary school achievement secondary school achievement tertiary school achievement alphabetization center achievement lower primary level index, combined achievement index educational attainment index, educational level index child mortality and male and female headed households

2 2 1 Adult literacy and illiteracy

The adult literacy rate (ALR) is processed as follows

$$\mathbf{ALR = num\_ALR * 100 \ / be\_10\_100}$$

Where

Num_ALR is the number of people who read or write by administrative unit

Be_10_100 is the number of people aged between 10 and 100 years old

The following formula gives the adult literacy rate for male **(hom_ALR)** and female **(muj_ALR)**

$$\mathbf{Hom\_ALR = hom\_num\_ALR * 100 \ / hom\_be\_10\_100}$$

$$\mathbf{Muj\_ALR = muj\_num\_ALR * 100 \ / muj\_be\_10\_100}$$

In order to derive the illiteracy rate (ILR) this formula is applied

$$\mathbf{ILR = num\_ILR * 100 / be\_10\_100}$$

Where

Num_ILR is the number of people who don t read or write by administrative unit

2 2 2 Primary School Achievement

The primary school achievement is derived as follows

$$x = num\_primary * 100 / be\_7\_12$$

Where

x is the primary school achievement

num_primary is the number of people between 7 and 12 years old who have achieved primary school education

be_7_12 is the total number of people between 7 and 12 years old

2 2 3 Secondary School Achievement

The secondary school achievement is derived as follows

$$y = num\_secondary * 100 / be\_13\_18$$

Where

y is the secondary school achievement

num_secondary is the number of people between 13 and 18 years old who achieved secondary school education

be_13_18 is the number of people between 13 and 18 years old

2 2 4 Tertiary School Achievement

The tertiary school Achievement is derived as follows

$$z = (num\_university + num\_technical) * 100 / be\_19\_22$$

Where

z is the tertiary school achievement

num_university is the number of people between 19 and 22 years old who have achieved university education

num_technical is the number of people between 19 and 22 years old who have achieved other types of post secondary education

be_19_22 is the number of people between 19 and 22 years old

2 2 5 Alphabetization center achievement

The alphabetization center achievement variable is defined as follows

$$t = num\_alpha * 100 / be\_40\_100$$

Where

t is the Alphabetization center achievement

num_alpha is the number of people between 40 and 100 years old who attend alphabetization center

be_40_100 is the number of people between 40 and 100 years old

2 2 6 Lower Primary Level Index

The lower primary level index is derived as follows

$$LPL = (num\_noeducation + num\_alpha + num\_preprimary + num\_primary) * 100 / be\_5\_100$$

num_noeducation is the number of people between 5 and 100 years old without education

num_alpha is the number of people between 5 and 100 years old who have attained alphabetization center educational level

num_preprimary is the number of people between 5 and 100 years old who have attained preprimary school level

num_primary is the number of people between 5 and 100 years old who have attained primary education level

be_5_100 is the number of people between 5 and 100 years old

2 2 7 Combined Achievement Index

The combined achievement index is derived as follows

$$CAR = (x + y + z) / 3$$

We have also processed another combined achievement index (**ACAR**) which includes the rate of people who have attained alphabetization center educational level

$$ACAR = (x + y + z + t) / 4$$

2 2 8 Educational Attainment Index

The educational attainment index is derived as follows

$$EAI = (2*ALR + CAR) / 3$$

We have also processed the educational attainment index that includes the ACAR index

$$AEAI = (2*ALR + ACAR) / 3$$

2 2 9 Educational Level Index

The educational level index is derived as follows

$$ELI = 75 * ILR / 100 + 25 * LPL / 100$$

CASERIO, ZONA, BARRIO, SEGMENTO, VIVIENDA, MANZANA, N_PERSONAS These field types prohibit any duplicate loading of rows during data automation (see annex for more details)

3 2 Data integration at individual and household level

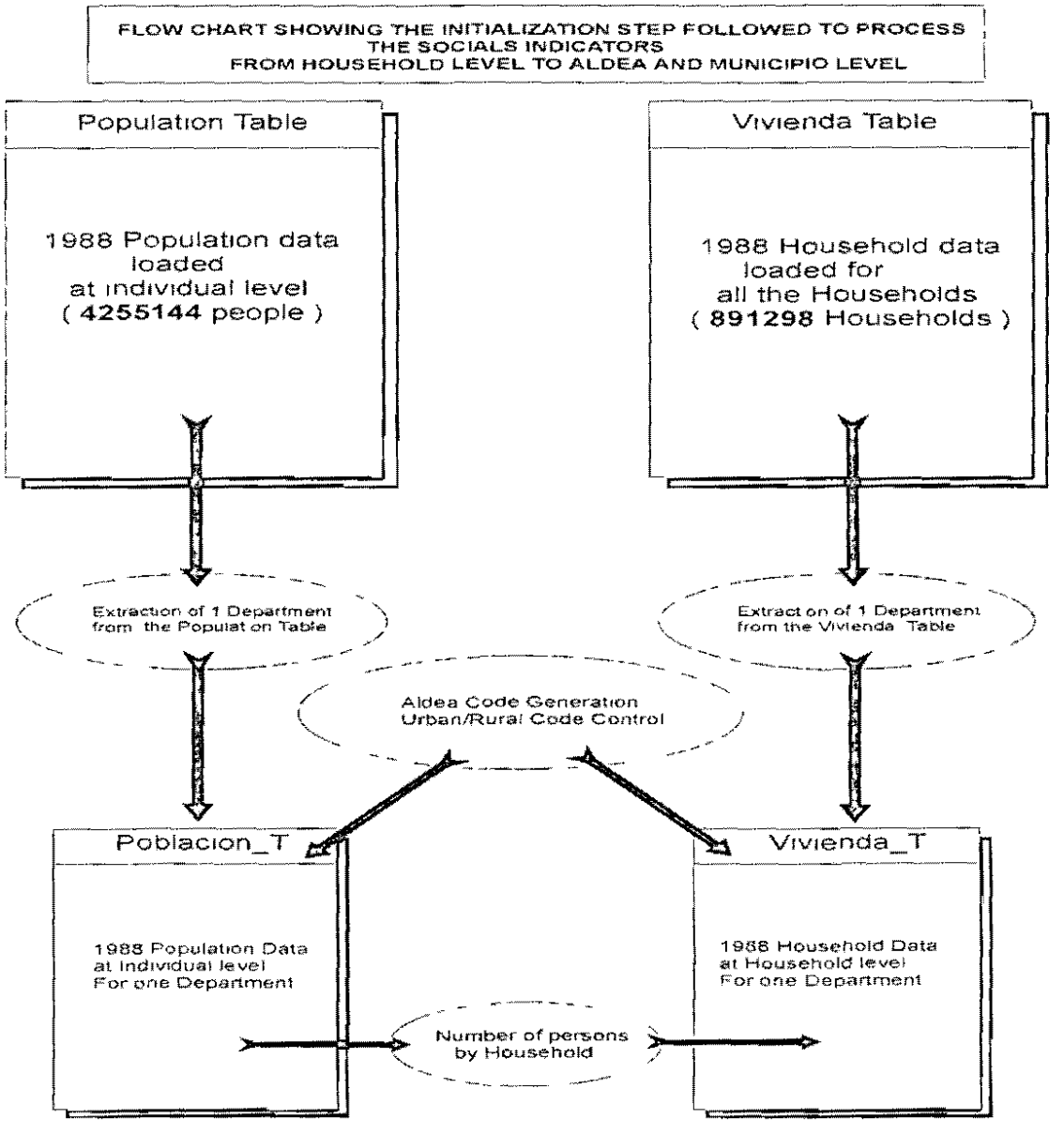
In order to load the population data some rows have been updated The code attributed per individual and household (N_PERSONAS) is the same However a digit of 9 is added to allow these rows to be loaded For example, if there were 2 rows with the same code 10 within the same household this code is updated to 910 (see annex for more details) The resulting total number of people in the database is 4255105 and the resulting total number of household is 891298

3 3 Oracle procedures to process household indicators at village and Municipal level

3 3 1 Initialization

To process household indicators at village and municipal level the two tables created above are used The figure 1 shows the logical steps used to initialize data before processing the indicators It is imperative to process the data by department to avoid the complexity and a very large amount of information when dealing with all the departments at the same time This saves physical and memory space within the database As shown by this figure the population and household data duplicated into the 2 intermediate tables (*Poblacion_t* and *Vivienda_t*) During the process the village codes are first generated and classified as rural and urban areas using the criteria of less than 2000 people or more than 2000 people respectively

Figure 1



3 3 2 Processing indicators

The next step is to start the actual processing of indicators Data that is used to process these indicators are stored in the 2 intermediate tables mentioned above All the steps to process the indicators are realized through a flow of Oracle procedures developed in PL/ SQL language Another set of Oracle procedures is used to aggregate indicators at village

and municipal level A written script ensures a fully automation of the entire process The results are then exported to Microsoft Excel

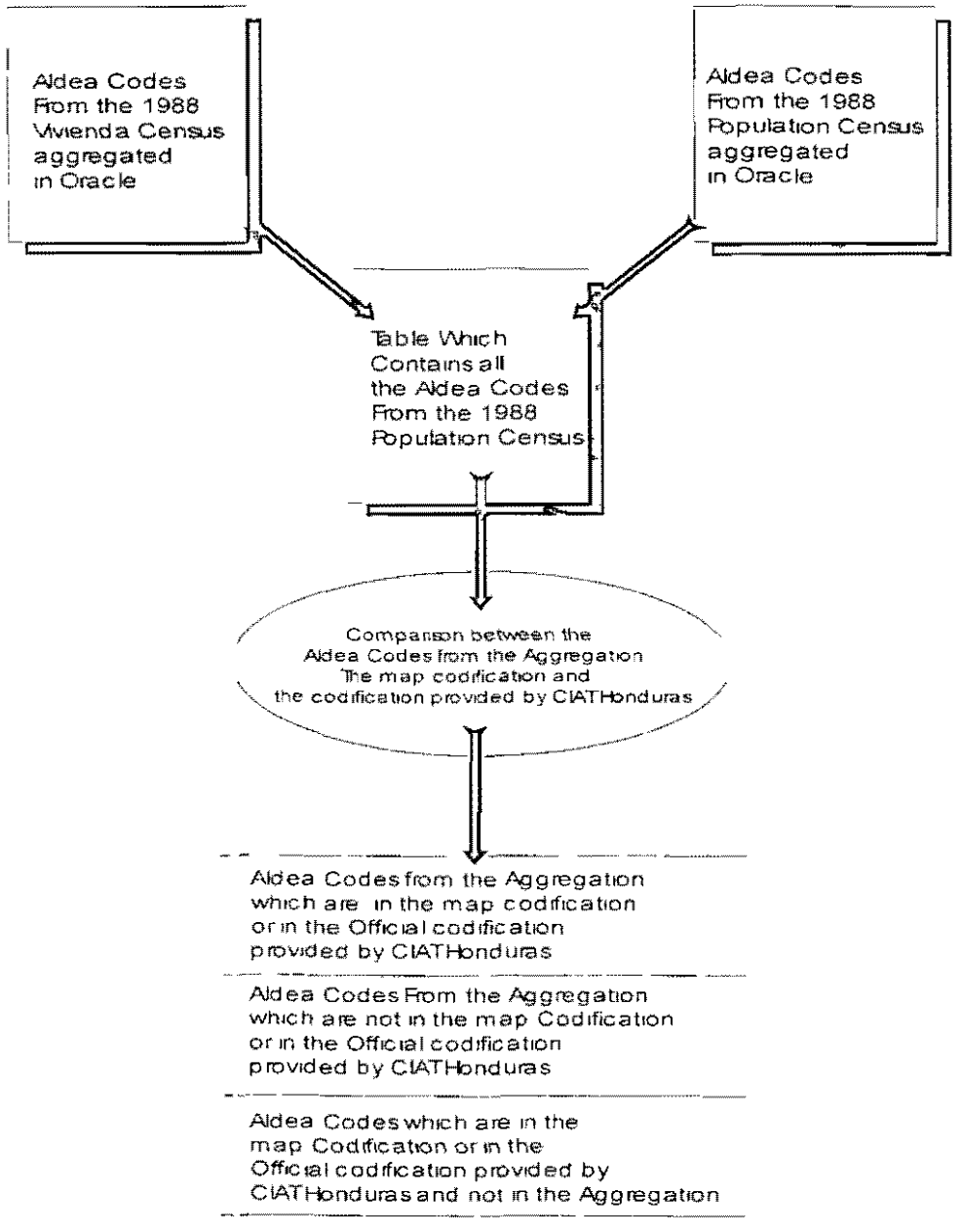
4 0 Cross Checking Results with Official Census Publications

It should be noted that data consistency, coherence and robustness is maintained by a cross checking procedure developed by using the loaded official figures of population per villages and the available hardcopies supplied by different actors (see also Table 4) The population census is first aggregated at village level and then compared to official census data sources as shown below in the flow chart (fig 2) The village codes returned in the census and the geo-reference village codes derived from ARC/INFO coverage are also compared

Table 4 Shows the Summary of the Aggregation and the Relative differences

Department Name	Population Second Aggregation From the second data set (3)	Population First Aggregation	Population Official Figures Provided By CIAT Honduras (2)	Population Official Figures From the Ministry of Statistics (5)	Relative Difference Between the Second Aggregation and the Official Figures (%)	Relative Difference Between the First Aggregation and the Official Figures (%)	Relative Difference Between the Second Aggregation and the First Aggregation (%)
ATLANTIDA	229318	229849	238741	238741	3 94	3 72	0 23
COLON	144003	144387	149677	149677	3 79	3 53	0 26
COMAYAGUA	230672	231143	243074	239859	3 10	4 90	0 20
COPAN	211261	211628	219466	219455	3 74	3 57	0 17
CORTES	631556	633096	662769	662772	4 70	4 47	0 24
CHOLUTECA	284313	285034	295482	295484	3 77	3 53	0 25
EL PARAISO	244919	245390	254291	254295	3 68	3 50	0 191
FRANCISCO MORAZAN	782020	669081	828273	828274	5 58	19 21	16 87
GRACIAS A DIOS	33791	33916	34968	34970	3 36	3 00	0 36
INTIBUCA	120054	120354	124682	124681	3 71	3 47	0 24
ISLAS DE LA BAHIA	21238	21441	22063	22062	-3 73	2 81	0 94
LA PAZ	101982	102112	105926	105927	3 72	3 60	0 12
LEMPIRA	170689	171211	177061	177055	3 59	3 30	0 30
OCOTOPEQUE	71554	71684	74281	74276	3 67	3 49	-0 18
OLANCHO	273242	274011	283854	283852	3 73	3 46	0 28
SANTA BARBARA	268438	268784	278870	278868	3 74	3 61	0 12
VALLE	115383	115565	119959	119965	-3 81	-3 66	0 15
YORO	320711	299192	333501	333508	3 83	10 28	7 19

Fig 2 Flow Chart Showing the Steps Followed To Compare The Aldea Codes From The 1988 Census Data Aggregation With the Official Publication Of Honduras and the map Codification



5 0 Handling Geographical Information

5 1 Checking Arc/Info Aldea coverage

The next task is to integrate the spatial and attribute data resulting from ARC/INFO and the population data available in the Oracle database Both data types have been cross-checked systematically to enhance their quality before the final integration For example establishing consistency between the villages and census codes checks the spatial data of Honduras Also the hard copy maps are used to check for the location of villages The major limitations are the continuous evolution of new villages, the changing boundaries and the dynamic nature of spatial data make the task a little harder However, by comparing the two datasets viz Census and spatial codes allocated to the villages in Honduras some anomalies are established and corrected First the duplicated points in the coverages are eliminated For instance the initial coverage[4] contained 3660 points 132 have been dropped Second some AML procedures are developed to cross-check the consistency between the municipal codes contained in the village code and the municipal code that is integrated from point data in an intersection between the municipals coverage and the village coverage (see fig 3 below)

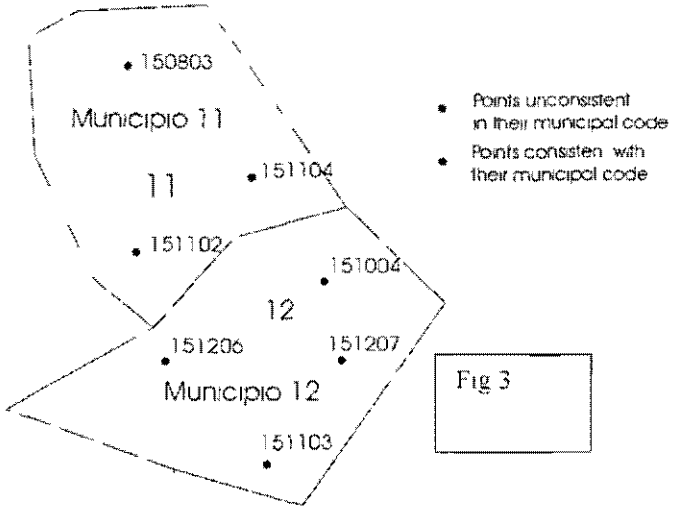


Fig 3

Furthermore another AML procedure is used to calculate the distance between 2 villages If the resulting distance between some villages is 0 and 300 meters then those villages are dropped from the coverage The updated coverage contains another field type (*accuracyfin)* that shows users the degree of consistency between the original and the new coverage (see Table 5)

Table 5 A Summary of Errors Checked within the Spatial Data

Consistency with the Municipal code	Distance between 2 Villages	Accuracyfin	Number of Villages
Not Consistent (0)	0 meters	Very Bad (-1)	4
Not Consistent (0)	0 – 300 meters	Bad (0)	10
Not Consistent (0)	> 300 meters	Bad (0)	276
Consistent (1)	0 meters	Medium (1)	25
Consistent (1)	0 – 300 meters	Good (2)	32
Consistent (1)	> 300 meters	Very good (3)	3313

5 2 A link between the Aldea codes from Oracle and Arc/Info coverage

The relationship between the village codes in the Oracle and the ARC/INFO coverage is also established This is done to maintain data consistency and integrity between the village codes reported in the Polygon Attribute Table (PAT) and the census codes used to represent these villages All the redundant codes are weeded out in both cases and matched together In total 3660 village points are geo-referenced and a column is created in Oracle and this becomes the unique identifier between ARC/INFO and Oracle

[4] This coverage needs further updating to bring it to the number of villages available in Honduras

5 3 Presentation of Results

5 3 1 Introduction

This section presents the resulting indicators derived from the census data of 1988 as an attempt to understand poverty in Honduras It should be noted, however that ten years have passed since this census was conducted and therefore relying on these results alone would be misleading in determining and measuring of the status of poverty in 1998 Probably a prediction model could be used to add value to the 1988 census data by forecasting and projecting it to the current time line it may then improve geographic poverty targeting But the strength of the results lies in testing a GIS technique/ methodology and its capability in managing large datasets in spatial terms and localizing this information at a micro-level

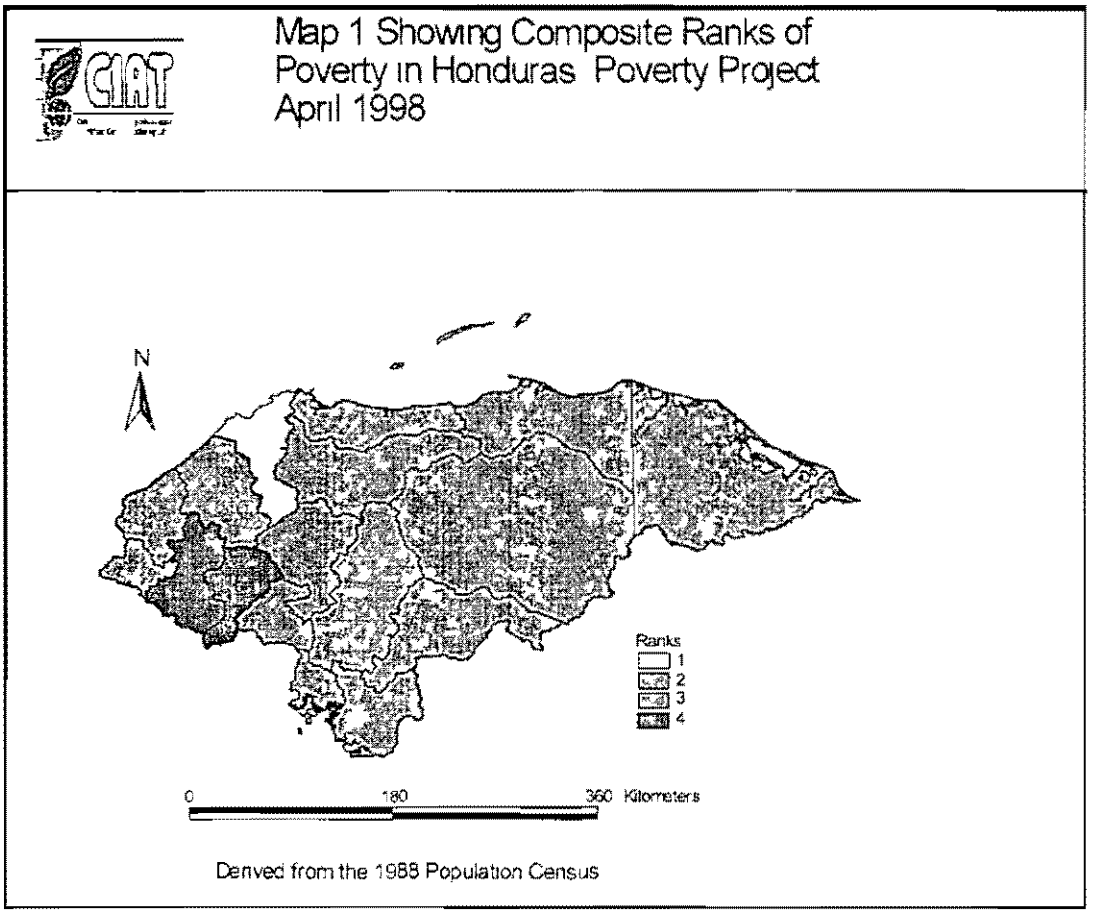
The processed indicators also compare very well with other methods used and the poverty studies that have been conducted in Honduras as will be discussed in section 5 4 This comparative analysis provides that level of confidence and justification required in using these results to assess poverty in Honduras

The results have been derived from individual household and sub-nationally levels In addition all the results are aggregated at national level in order to understand the trends and patterns on how this methodology characterizes and assesses poverty Furthermore this effort also evaluates whether this adapted approach over-estimates or under-estimates the magnitude of poverty using that time line of 1988 The results are presented in four sub-sections The first sub-section 5 3 1 deals with the major 4 composite indicators with some examples provided and illustrated at local and sub-nationally level In addition, the sub-section provides the overall national situation in order to compare the results with documented poverty studies in Honduras The next sub section 5 3 2 presents other 4 specific indicators viz an indicator that depicts the size and quality of households ($\mathbf{CV_j}$)

an indicator that depicts basic services (**$CSIB_j$**), an indicator that measures education (**RE_j**) and the indicator that depicts the non-land assets (**CIA_j**) Last but not least other processed major socio-economic indicators that depict the level of human capital development are provided in sub-section 5 3 3 A conclusion is then drawn in light of these processed results

5 3 2 Composite Indicators Showing the Level of Non-Satisfaction

At national level this method shows that 55 11 % and 58 74 % of the total population do not meet the defined satisfaction criteria as measured by the 2 derived composite indicators referred to as type 1 (**P3_NBI_3**) and type 2 (**P3_NBI_4**) respectively (see Table 6) These two composite poverty measures are designed to assess 3-4 types of satisfiers at different scales starting at micro to macro-level a) size and quality of households b) the level of human capital development c) basic services d) and other non-land assets that were surveyed in the population census The table also presents a poverty classification as stated in section 2 1 5 titled as poverty index 1 (**MAGP_3**) and poverty index 2 (**MAGP-4**) The ranks are allocated according to the classification defined in Tables 2 and 3



The radar chart shown in fig 4 presents the 3 cases of not so worse off and the worse off The wider the size of polygon of the described composite poverty measure in a department the bigger the problem of poverty in that area so the smaller the polygons the better off there are

The hardest hit departments are Intibuca and Lempira all ranked with a value of 4 Next in the same classification are the departments of Olancho (ranked 3 fours and 1 three) Valle (ranked 2 threes and 2 fours) and La Paz (ranked 2 threes and 2 fours) The departments of El Paraiso and Gracias A Dios are relatively well off as compared to these above-mentioned categories there are ranked with 3 threes and 1 four In fact, Comayagua, Copan Ocotepeque and Santa Barbara departments all fall in the same rank of 3 that are classified as not too worse off Nonetheless the better off departments as far as this measurement of satisfaction is concerned are Islas De La Bahia and Cortes all ranked with one and Francisco Morazan with a rank of 2 twos and 2 ones (see also map 1 to map 9 and fig 4)

Fig 4 Radar Chart Showing the Not so Worse off and the Worse off in Honduras

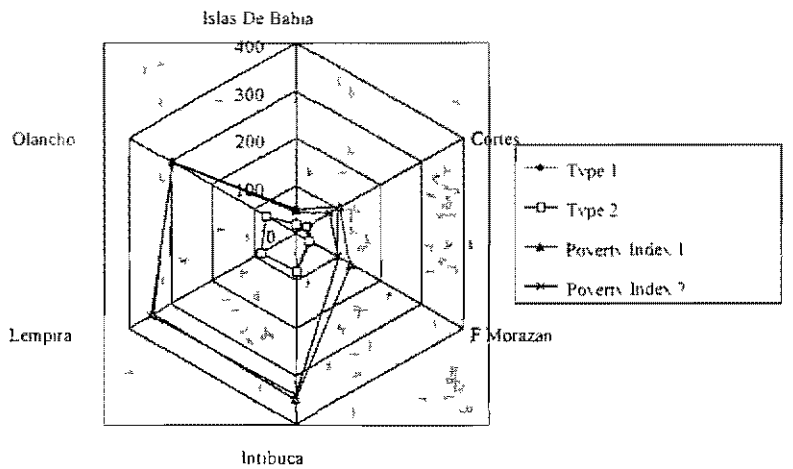


Table 6 showing the Magnitude of Poverty across Departments in Honduras

NAME	TYPE 1	RANK	TYPE 2	RANK	POVERTY INDEX 1	RANK	POVERTY INDEX 2	RANK
Atlantida	47 19	2	36 74	2	165 73	2	124 18	2
Colon	66 25	3	53 87	2	245 23	3	192 82	2
Comayagua	60 84	3	60 51	3	232 79	3	229 32	3
Copan	72 47	3	73 34	3	265 85	3	276 81	3
Cortes	32 09	1	24 87	1	104 49	1	79 10	1
Choluteca	72 67	3	58 35	2	278 99	3	217 71	3
El Paraiso	69 92	3	70 14	3	277 94	3	281 18	4
Francisco Morazan	36 67	2	29 73	1	129 49	2	102 13	1
Gracias A Dios	74 69	3	59 40	3	283 51	4	215 73	3
Intibuca	80 51	4	79 08	4	350 29	4	337 60	4
Islas De La Bahia	18 69	1	18 10	1	50 01	1	45 60	1
La Paz	69 90	3	69 01	3	295 87	4	289 15	4
Lempira	81 45	4	81 55	4	341 57	4	347 19	4
Ocotepeque	63 56	3	65 71	3	233 51	3	243 04	3
Olancho	70 25	3	69 56	4	296 60	4	293 04	4
Santa Barbara	69 63	3	71 26	3	251 80	3	261 71	3
Valle	74 18	3	72 62	3	294 34	4	280 83	4
Yoro	55 20	3	53 34	2	208 16	3	197 97	2
Average	**58 74**		**55 11**					

5 3 3 Some Specific Indicators

This section presents the number of households in 6 classes that show the lack of the 2 composite indicators (see fig 5 and 6) measuring satisfaction levels (**NBI_3** and **NBI_4**) In addition other specific indicators are also provided These include the size and quality of households basic services measured at household level education measured at household level and other non land assets that were surveyed in the census (see previous section 2 1 3) Both fig 5 and fig 6 reveal that (a) most of the households fall in class 2 and 3 with more than 50 % of the total households without the defined satisfaction levels (b) about 7 % of the total households fall in class 4 and 5, (c) 16 – 20 % of the total households were returned as having no data

Fig 5 showing composite indicator(NBI_3) at household level

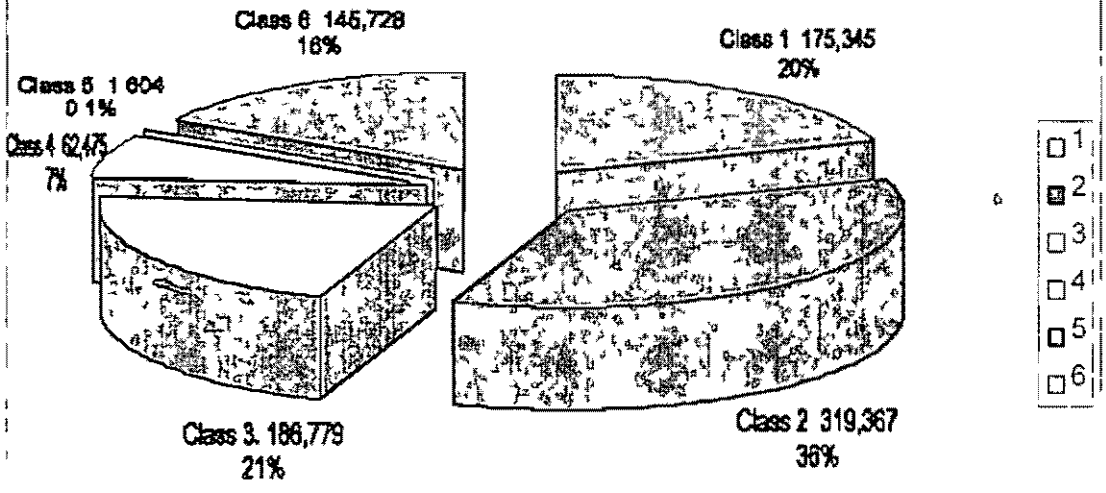


Fig 6 showing composite indicator(NBI_4) at household level

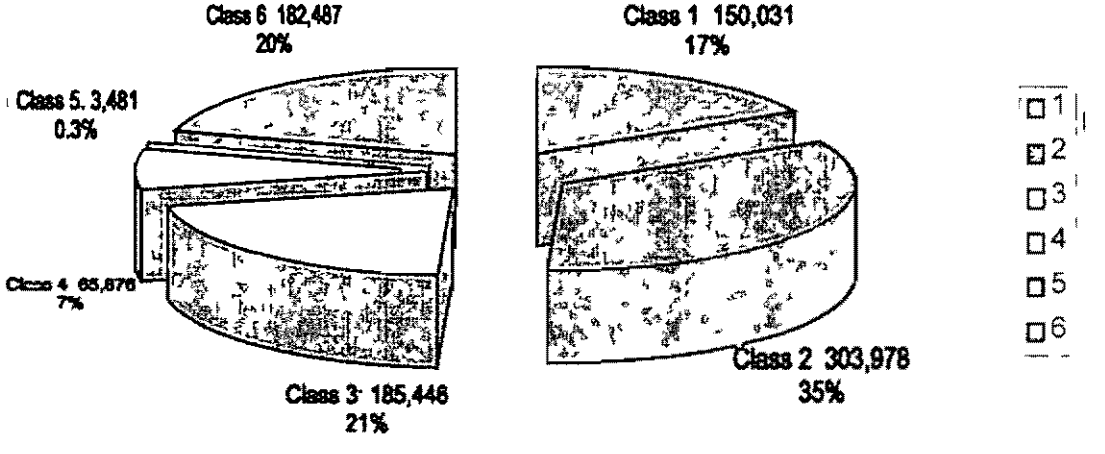


Fig 5 and Fig 6 show the distribution of the households in the 6 defined strata of poverty

Table 7 shows the distribution of the 4 specific indicators at household level used to produce the 2 composite indicators of satisfaction

Table 7 The distribution of specific indicators by households

	The Number of Households				
Stratum	**Category**	**Size & Quality**	**Basic Services**	**Education**	**Non-Land Assets**
1	Extreme Poor	71479	115974	181168	513518
2	Poor	276315	244622	209565	155711
3	Moderate Poor	230200	189056	204863	89646
4	Threshold of Poverty	113977	185219	90457	3190
5	Above Threshold	65773	14867	39514	0
6	NO Data	133554	141560	165931	129233

A closer look at Table 5 reveals the following (a) only 512 797 (57 53 %) lie in threshold or above (b) about 633 764 (71 1 %) households possess limited basic services (c) about 669 229 (75 1 %) households lack non-land assets (d) about 544 199 (61 1 %) possess basic education (e) for all the indicators processed on average about 142,569 (15 99 %) households had no data to process the required indicators

5 3 4 Other Socio-economic Indicators

The socio-economic indicators presented in this section depict the status and level of human capital development by gender proportions at individual village municipal department and national level In addition, other indicators showing the geographic

distribution of child mortality male and female-headed households are also provided A big picture (see annex 1 for details) of the status of human capital development shows that

(a) the hardest hit departments with low levels of human capital development and high child mortality rates are Lempira and Copan
(b) females have higher Primary and secondary school achievement than males at national level (see fig 7),
(c) adult literacy rate is 68% at national level (see Table 8),
(d) primary school achievement for the age bracket between 7 and 12 years is 64 49% at national level

Table 8 Shows the Distribution of illiteracy and literacy rates by Department and Sex

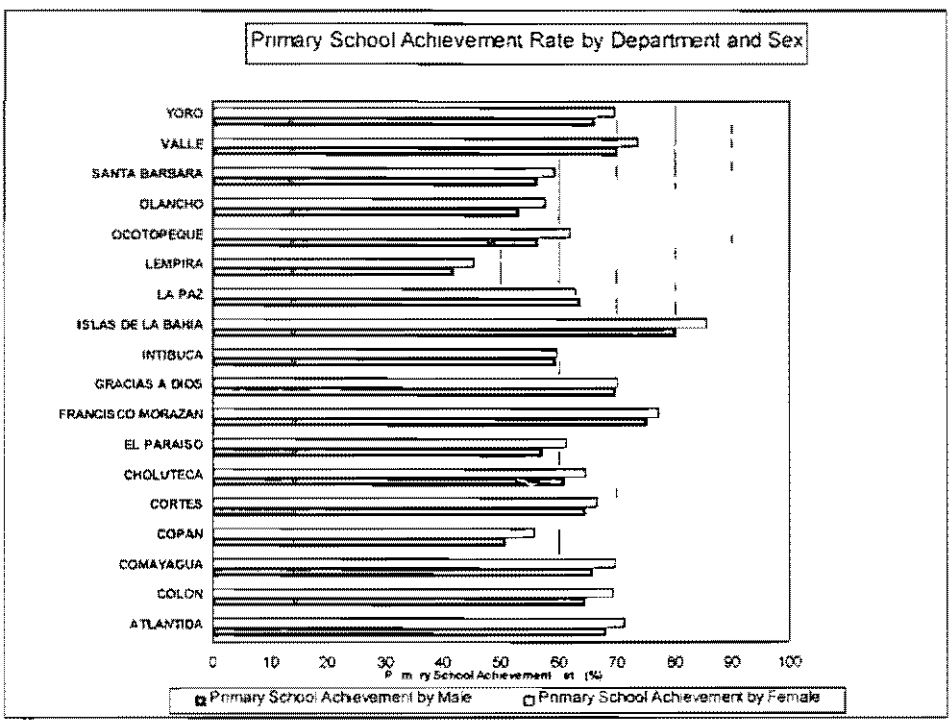
Department Name	Illiteracy Rate	Illiteracy Rate by Male	Illiteracy Rate by Female	Literacy Rate	Literacy Rate by Male	Literacy Rate by Female
Atlantida	25 82	26 45	25 21	74 18	73 55	74 79
Colon	31 97	31 90	32 05	68 03	68 10	67 95
Comayagua	30 14	31 04	29 26	69 86	68 96	70 74
Copan	47 26	48 07	46 46	52 74	51 93	53 54
Cortes	25 71	25 14	26 24	74 29	74 86	73 76
Choluteca	36 55	37 35	35 76	63 45	62 65	64 24
El Paraiso	39 54	40 18	38 90	60 46	59 82	61 10
Francisco Morazan	18 86	18 46	19 20	81 14	81 54	80 80
Gracias a Dios	34 73	28 32	40 55	65 27	71 68	59 45
Intibuca	40 79	34 79	46 82	59 21	65 21	53 18
Islas de la Bahia	11 36	11 37	11 35	88 64	88 63	88 65
La Paz	36 08	31 24	40 59	63 92	68 76	59 41
Lempira	54 68	54 06	55 30	45 32	45 94	44 70
Ocotopeque	42 07	42 87	41 29	57 93	57 13	58 71
Olancho	40 60	41 26	39 93	59 40	58 74	60 07
Santa Barbara	44 21	43 53	44 94	55 79	56 47	55 06
Valle	34 81	34 54	35 07	65 19	65 46	64 93
Yoro	30 16	30 58	29 74	69 84	69 42	70 26

(e) low secondary school achievement rates with Lempira Intibuca Copan Gracias A Dios and Santa Barbara departments having less than 10 % (see fig 8)

(f) higher achievement rates for males than females for tertiary education

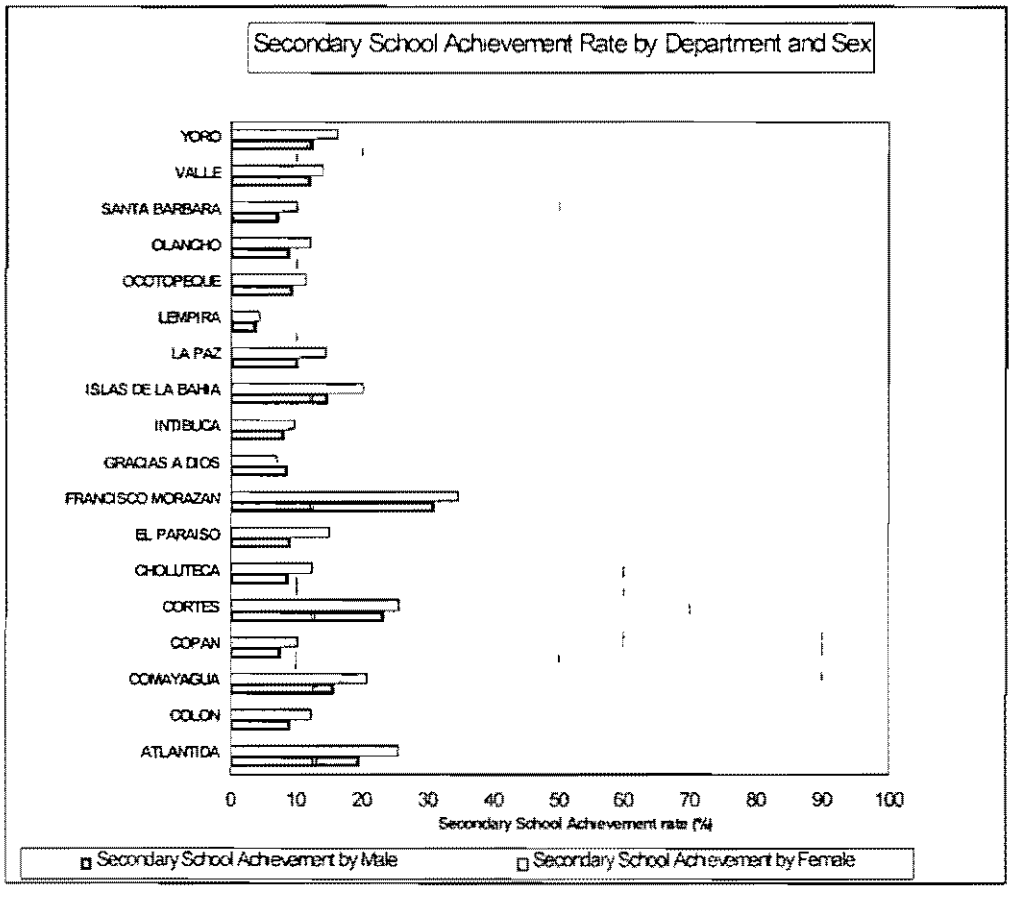
(g) fewer adults attend alphabetical centers only less than 1% for all the departments

Fig 7 The Distribution of Primary School Achievement Rates by department and Sex



(h) Low combined school achievement rates and overall educational attainment index is 54 84 % (see fig 9)

Fig 8 Showing the Distribution of Secondary School Achievements by Department and Sex



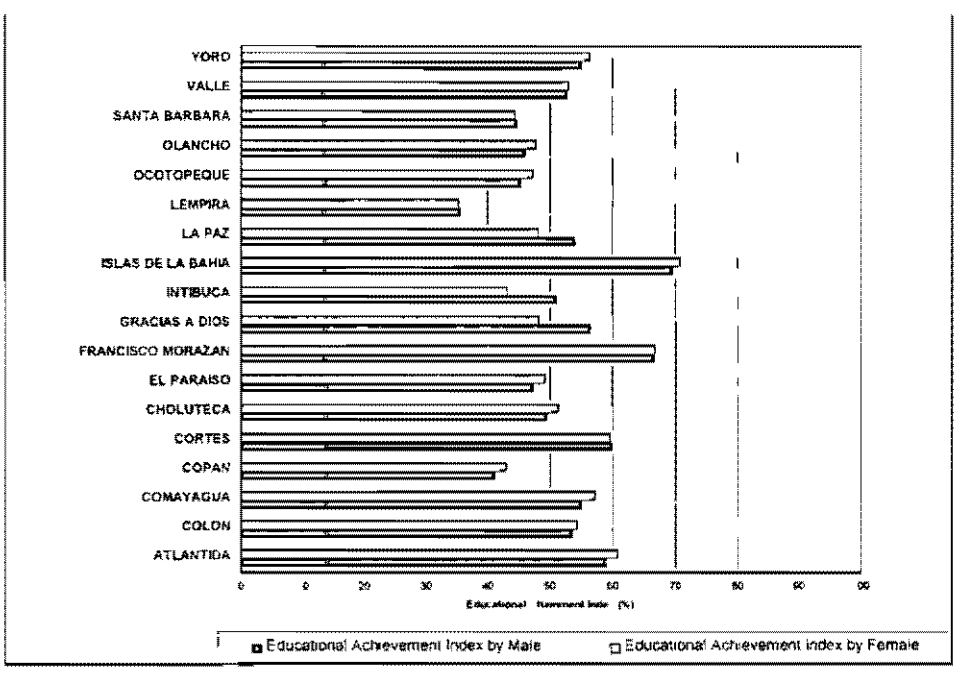
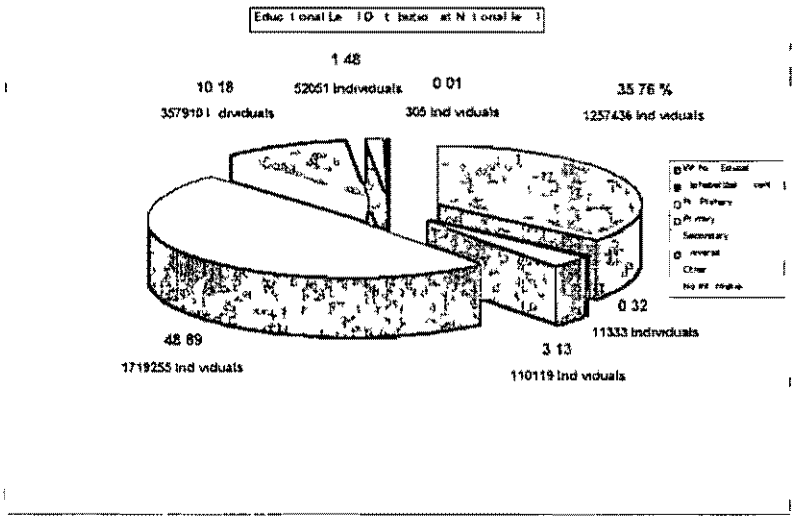


Fig 10 Showing the Distribution of the level of Education at household level



5 4 Discussion of Results

In discussing these results there are 3 important questions that should come to one's mind (a) does this method/ technique applied over or underestimate poverty? (b) How do these resulting indicators compare with other evaluations using the 1988 time line and poverty studies? (c) Can we make a geographic characterization of poverty at micro-level on the basis of census data?

For us to test this technique we had to work at municipal department and national scale since the data and results available from other studies mainly reflect the status of poverty at these scales The two composite measurements used in this study estimates that 55 11 % and 58 74 % of the total population as lacking the defined levels of satisfaction compares quite well with other poverty profiles constructed during this period (see the World Bank 1994 FHIS 1993 and Ministry of Planning Honduras estimates)

For instance the ministry of planning estimated in 1992 that 55 % of the total households were very poor and the poor (including the very poor) comprised 72 % Another study by the Permanent Household Survey of 1992 showed that out of 56 % of the total rural households 78 % were poor and out of the 44 % of the total urban households of these 22 % were poor About 42 % and 15 % of the total households in both categories (rural and urban) were found to be in poverty respectively The World Bank estimates in 1989 showed that 36 % were very poor and 55 % were poor

At department level FHIS study of 1993 shows that the departments of Gracias A Dios, Intibuca Lempira and Valle were the worst hit If this is compared to this methodology these departments still come out as the hardest hit with the departments of Islas De La Bahia, Cortes and Francisco Morazan relatively better off (see also SECPLAN 1992 survey of households with 3 or more non-satisfied basic needs)

To come back to the first question posed, does this technique under or over estimate poverty? We would argue that the estimates are within the range of other studies at

national level however it is important to cross check these results at micro-level especially in those areas that reported low turnout in terms of numbers during the population census Involving the local main stakeholders to verify and adjust some of these indicators to satisfy their local conditions can further enhance the accuracy of this methodology

By focusing further on the level of human capital development in Honduras we will be able to respond to the second question posed This modified method[5] used in determining these educational indicators at micro-level presents a very conclusive result that compares very well with other studies conducted during this period in the study area (see also Edwards, 1995 who conducted the USAID study and Regional Statistics in Education Ministry of Education Planning Division) The detailed USAID study considers 16 departments for mean educational attainment and ranks the top four as Francisco Morazan Cortes Altantida and Yoro whereas the Copan Octopeque Intibuca and Lempira are in the lower ranks - the educational attainment index in this study tallies with these findings too In addition another report on the National Household Consumption Income Expenditure and Nutrition survey of 1994 places the rural west[6] as the most deprived region by every measure The literacy rates presented in section 5 3 4 are similar to the Regional Statistics in Education submitted by the Ministry of Education from micro to macro-level Therefore, the human capital development status of Honduras in 1988 significantly compares well with the resulting educational indicators derived from the census data

Finally, despite some conceptual and methodological limitations of using census data to study poverty It is possible to draw some conclusions on the status of poverty at micro-level using census data since population is a major driving force in the whole socio-economic development process Understanding the details of a village and mapping them helps to bring the policy design process at micro-level in terms of assessing a village

[5] This approach draws from the proposed UNDP method used in calculating the Human Development Index

[6] Lempira and Intibuca are geographically located in the west and this technique finds them lacking in all measures

human resource potential the basic needs health status shelter status and perhaps introducing the concept of participatory planning within local institutions

Resources are increasingly becoming highly competitive so the provision of timely and up-to-date information is instrument in aiding the right decisions for very competitive projects By establishing benchmarks at micro-level through GIS functions deficit and surplus areas can quick be identified and targeted effectively In addition, appropriating these scarce and yet very competitive financial resources or investing requires micro-level information that the GIS functions and the processed census data can readily provide These micro-level benchmarks help in setting funding and spending criteria in the least and most favored areas for investment

So all in all population census[7] provides a platform for assessing poverty at micro-level since there are not many other best data available sources in most developing countries A comprehensive population census can provide village demographic some educational some employment and health data that is useful in the spatial characterization of poverty In a nutshell it is possible to use census data for a geographic characterization of poverty at micro-level like this method demonstrates However two issues must be addressed to make census data more reliable and valid for assessing poverty First, census data must be up-to-date and second it should be largely inclusive - at least incorporating other socio-economic variables that are used to characterize poverty

5 5 Conclusion

Several indicators of poverty have been derived at household and village scales and presented graphically These scales allow for a comparison and a contrast of the level of poverty among villages spatially and could provide a better basis for assessment of poverty and also improve targeting efforts aimed at reducing poverty This methodology breaks new ground as a GIS technique aimed at localizing census data and also a means for effective studying of poverty It must be noted however that census data alone is

[7] See section 5 5 also for more discussion of census data

necessary but not sufficient enough for an in-depth understanding of poverty Other data sources should be used to complement the approach

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Annex 1

The Status of Human Capital Development by Gender Proportions

Primary and Secondary School Achievement by Department and sex

Department Name	Primary School Achievement	Primary School Achievement by Male	Primary School Achievement by Female	Secondary School Achievement	Secondary School Achievement by Male	Secondary School Achievement by Female
Atlantida	69 81	68 24	71 46	22 71	19 78	25 64
Colon	66 95	64 66	69 35	10 69	9 19	12 26
Comayagua	67 85	65 91	69 86	18 33	15 79	20 91
Copan	53 25	50 83	55 77	9 08	7 77	10 37
Cortes	65 63	64 69	66 59	24 52	23 30	25 69
Choluteca	62 82	61 06	64 62	10 69	8 84	12 56
El Paraiso	59 19	57 22	61 22	12 14	9 25	15 04
Francisco Morazan	76 20	75 21	77 22	32 90	30 95	34 68
Gracias a Dios	69 92	69 78	70 06	7 81	8 64	7 07
Intibuca	59 62	59 53	59 71	8 93	8 18	9 73
Islas de la Bahia	82 75	80 14	85 48	17 48	14 76	20 25
La Paz	63 41	63 84	62 97	12 50	10 37	14 59
Lempira	43 62	41 95	45 42	4 18	3 95	4 42
Ocotopeque	59 27	56 59	62 07	10 54	9 54	11 53
Olancho	55 46	53 22	57 81	10 58	9 02	12 23
Santa Barbara	57 84	56 37	59 43	8 68	7 32	10 17
Valle	71 81	70 15	73 60	13 14	12 17	14 16
Yoro	67 84	66 21	69 54	14 45	12 66	16 30

Tertiary and Alphabetical Center Secondary Achievement by Department and sex

Department Name	Tertiary School Achievement	Tertiary School Achievement by Male	Tertiary School Achievement by Female	Alphabetical Center Achievement	Alphabetical Center Achievement by Male	Alphabetical Center Achievement by Female
Atlantida	3 44	1 83	1 60	0 89	0 96	0 80
Colon	0 31	0 14	0 17	0 82	0 76	0 87
Comayagua	0 96	0 65	0 31	0 60	0 69	0 51
Copan	0 26	0 10	0 17	0 66	0 86	0 46
Cortes	3 36	1 67	1 70	0 75	0 77	0 73
Choluteca	0 42	0 29	0 13	0 83	0 95	0 72
El Paraiso	0 58	0 36	0 22	0 52	0 61	0 41
Francisco Morazan	10 36	5 16	5 20	0 66	0 67	0 65
Gracias a Dios	0 13	0 04	0 09	0 61	0 84	0 38
Intibuca	0 25	0 10	0 14	0 58	0 82	0 35
Islas de la Bahia	0 75	0 50	0 25	0 80	0 46	1 15
La Paz	0 26	0 13	0 13	0 57	0 79	0 38
Lempira	0 14	0 08	0 06	0 54	0 70	0 37
Ocotopeque	0 25	0 11	0 14	0 57	0 78	0 38
Olancho	0 73	0 57	0 16	0 50	0 45	0 54
Santa Barbara	0 28	0 17	0 11	0 79	0 93	0 62
Valle	0 27	0 12	0 15	0 63	0 70	0 57
Yoro	1 04	0 55	0 49	0 66	0 73	0 59

Lower Primary Level Index and Educational Level Index by Department and Sex

Department Name	Lower Primary Level Index	Lower Primary Level Index by Male	Lower Primary Level Index by Female	Educational Level Index	Educational Level Index by Male	Educational Level Index by Female
Atlantida	86 09	87 15	84 83	40 89	41 62	40 11
Colon	93 88	94 40	93 15	47 45	47 52	47 32
Comayagua	90 39	91 19	89 40	45 20	46 08	44 29
Copan	95 21	95 66	94 58	59 25	59 97	58 49
Cortes	82 79	83 22	82 18	39 98	39 66	40 22
Choluteca	93 51	94 12	92 71	50 79	51 54	50 00
El Paraiso	93 81	94 60	92 84	53 11	53 79	52 38
Francisco Morazan	74 89	75 35	74 28	32 87	32 68	32 97
Gracias a Dios	94 39	93 25	95 31	49 65	44 55	54 24
Intibuca	95 29	95 42	95 01	54 42	49 95	58 87
Islas de la Bahia	88 69	89 75	87 44	30 69	30 96	30 37
La Paz	93 26	93 89	92 50	50 37	46 90	53 57
Lempira	97 73	97 73	97 60	65 44	64 98	65 88
Ocotopeque	94 30	94 61	93 80	55 12	55 80	54 42
Olancho	94 08	94 47	93 55	53 97	54 56	53 33
Santa Barbara	95 27	95 25	95 06	56 97	56 46	57 47
Valle	92 90	93 09	92 50	49 33	49 17	49 42
Yoro	91 38	92 13	90 48	45 47	45 97	44 93

Combined Achievement Index and Adapted Combined Achievement Index by Department and Sex

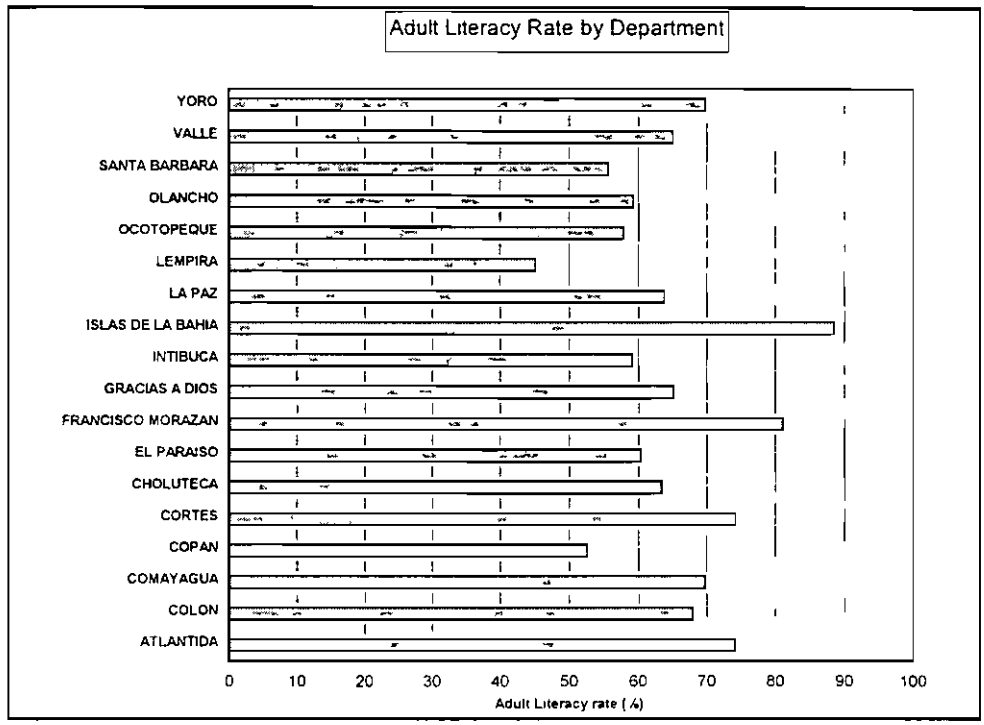
Department Name	Combined Achievement Index	Combined Achievement Index by Male	Combined Achievement Index by Female	Adapted Combined Achievement Index	Adapted Combined Achievement Index by Male	Adapted Combined Achievement Index by Female
Atlantida	31 99	29 95	32 90	24 21	22 70	24 88
Colon	25 98	24 66	27 26	19 69	18 69	20 66
Comayagua	29 05	27 45	30 36	21 93	20 76	22 90
Copan	20 86	19 57	22 10	15 81	14 89	16 69
Cortes	31 17	29 88	31 33	23 57	22 61	23 68
Choluteca	24 64	23 40	25 77	18 69	17 79	19 51
El Paraiso	23 97	22 28	25 49	18 11	16 86	19 22
Francisco Morazan	39 82	37 11	39 03	30 03	28 00	29 44
Gracias a Dios	25 95	26 16	25 74	19 62	19 83	19 40
Intibuca	22 93	22 60	23 19	17 34	17 16	17 48
Islas de la Bahia	33 66	31 80	35 33	25 45	23 96	26 78
La Paz	25 39	24 78	25 89	19 19	18 78	19 52
Lempira	15 98	15 33	16 63	12 12	11 67	12 57
Ocotopeque	23 35	22 08	24 58	17 66	16 76	18 53
Olancho	22 26	20 94	23 40	16 82	15 82	17 69
Santa Barbara	22 27	21 29	23 23	16 90	16 20	17 58
Valle	28 40	27 48	29 30	21 46	20 78	22 12
Yoro	27 78	26 47	28 78	21 00	20 04	21 73

Educational Attainment Index and Adapted Educational Attainment Index by Department and Sex

Department Name	Educational Attainment Index	Educational Attainment Index by Male	Educational Attainment Index by Female	Adapted Educational Attainment Index	Adapted Educational Attainment Index by Male	Adapted Educational Attainment Index by Female
Atlantida	60 12	59 02	60 83	57 52	56 60	58 15
Colon	54 01	53 62	54 39	51 91	51 63	52 19
Comayagua	56 26	55 12	57 28	53 89	52 89	54 80
Copan	42 12	41 14	43 06	40 43	39 58	41 26
Cortes	59 92	59 87	59 62	57 38	57 44	57 07
Choluteca	50 52	49 57	51 41	48 53	47 69	49 33
El Paraiso	48 30	47 30	49 23	46 34	45 50	47 14
Francisco Morazan	67 37	66 73	66 88	64 11	63 69	63 68
Gracias a Dios	52 16	56 51	48 21	50 05	54 40	46 10
Intibuca	47 12	51 01	43 18	45 25	49 19	41 28
Islas de la Bahia	70 31	69 69	70 88	67 58	67 08	68 03
La Paz	51 08	54 10	48 24	49 01	52 10	46 11
Lempira	35 54	35 73	35 34	34 25	34 51	33 99
Ocotopeque	46 41	45 45	47 33	44 51	43 67	45 32
Olancho	47 02	46 14	47 85	45 21	44 43	45 95
Santa Barbara	44 61	44 74	44 45	42 83	43 04	42 57
Valle	52 93	52 80	53 06	50 61	50 57	50 66
Yoro	55 82	55 10	56 43	53 56	52 96	54 08

Other Indicators by Department

Department Name	Child Mortality	Male Headed Household	Female Headed Household
Atlantida	13 78	77 87	22 13
Colon	15 69	79 85	20 15
Comayagua	13 22	79 39	19 11
Copan	19 21	80 24	18 59
Cortes	12 98	77 80	22 20
Choluteca	14 26	77 59	22 39
El Paraiso	16 15	80 35	18 18
Francisco Morazan	11 64	73 40	26 60
Gracias a Dios	9 25	75 10	24 90
Intibuca	17 03	79 65	18 86
Islas de la Bahia	10 54	73 45	26 55
La Paz	15 44	76 54	22 35
Lempira	17 62	77 77	21 10
Ocotopeque	15 32	78 24	20 52
Olancho	11 31	80 34	18 24
Santa Barbara	14 92	82 40	16 49
Valle	13 47	72 71	26 20
Yoro	14 23	79 58	19 47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OLANCHO
OCOTOPEQUE
LEMPIRA
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ISLAS DE LA BAHIA
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GRACIAS A DIOS
FRANCISCO MORAZAN
EL PARAISO
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CORTES
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COMAYAGUA
COLON
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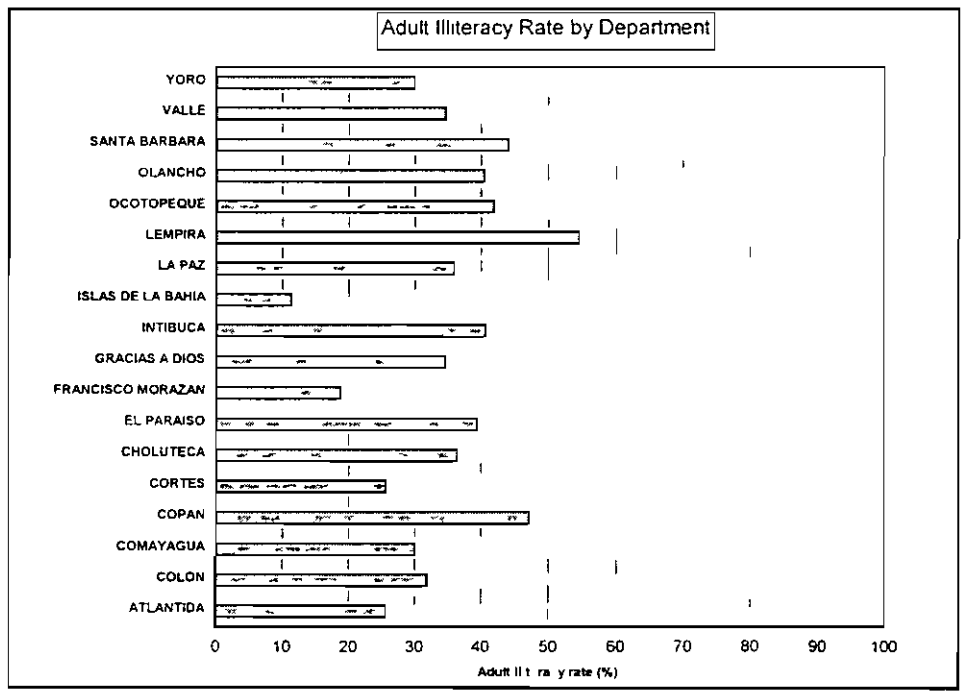
0 10 20 30 40 50 60 70 80 90 100
Adult Literacy rate (%)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GRACIAS A DIOS
FRANCISCO MORAZAN
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CORTES
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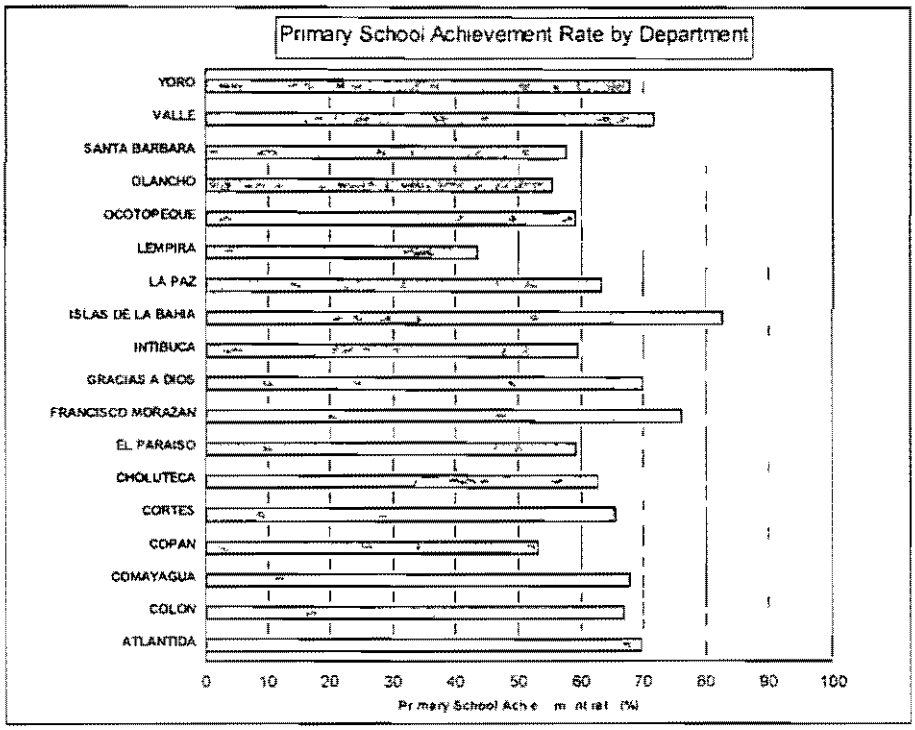
COLON
ATLANTIDA
0 10 20 30 40 50 60 70 80 90 100
Adult Illiteracy rate (%)


Primary School Achievement Rate by Department
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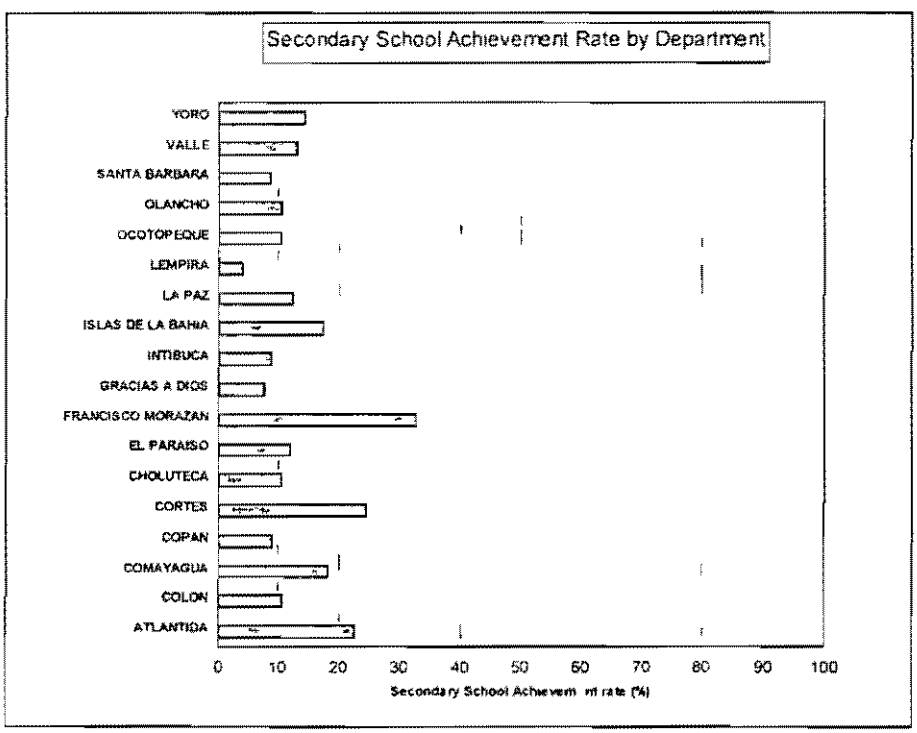
Secondary School Achievement Rate by Department
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GRACIAS A DIOS
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EL PARAISO
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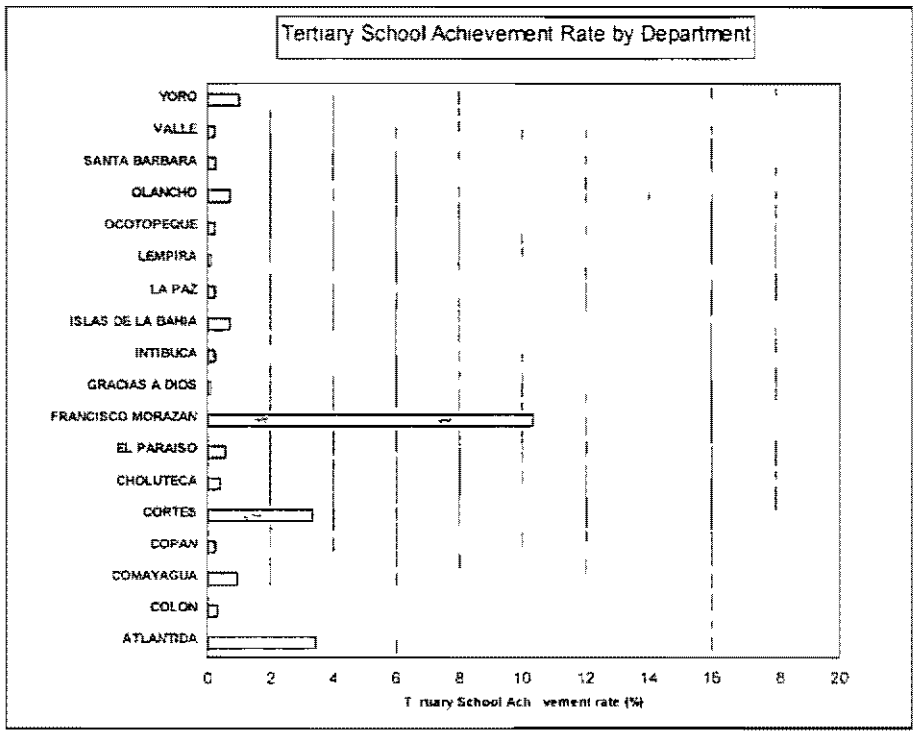
Tertiary School Achievement Rate by Department
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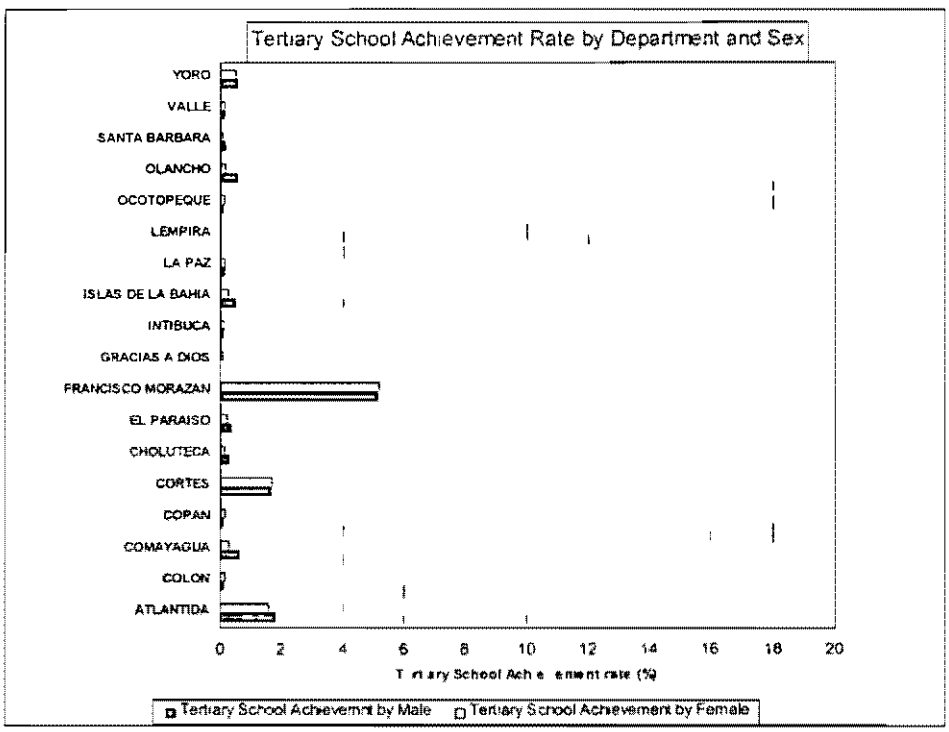
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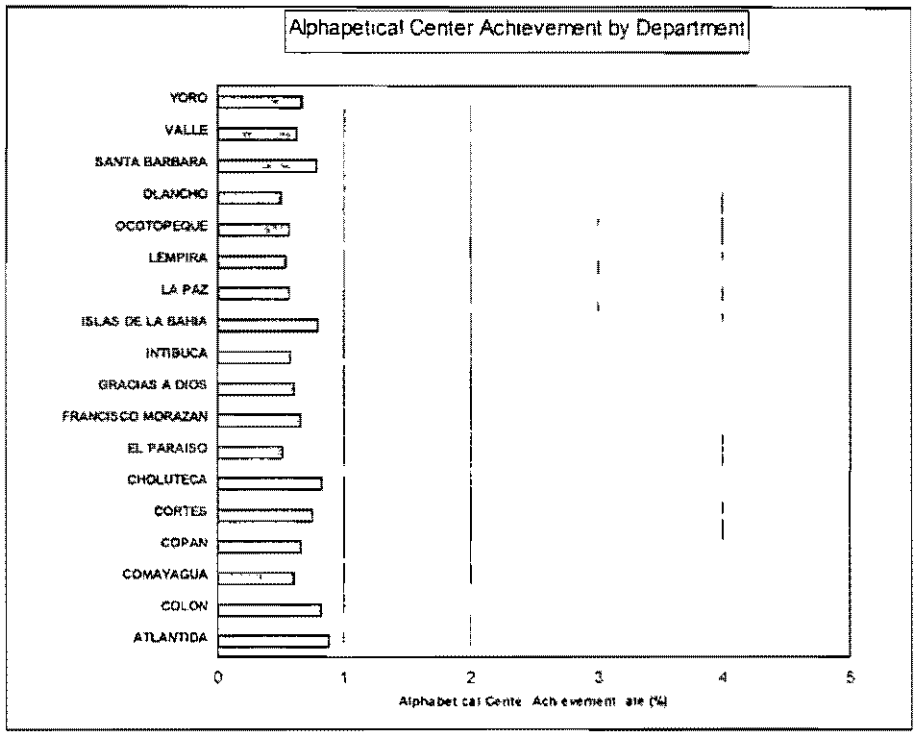
Tertiary School Achievement by Female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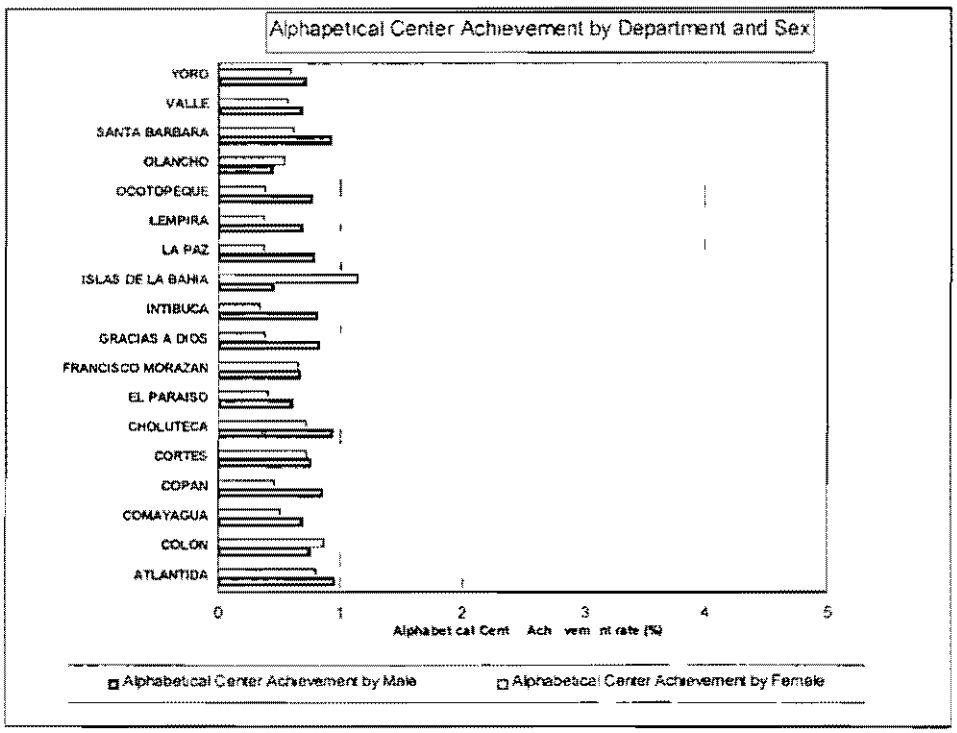
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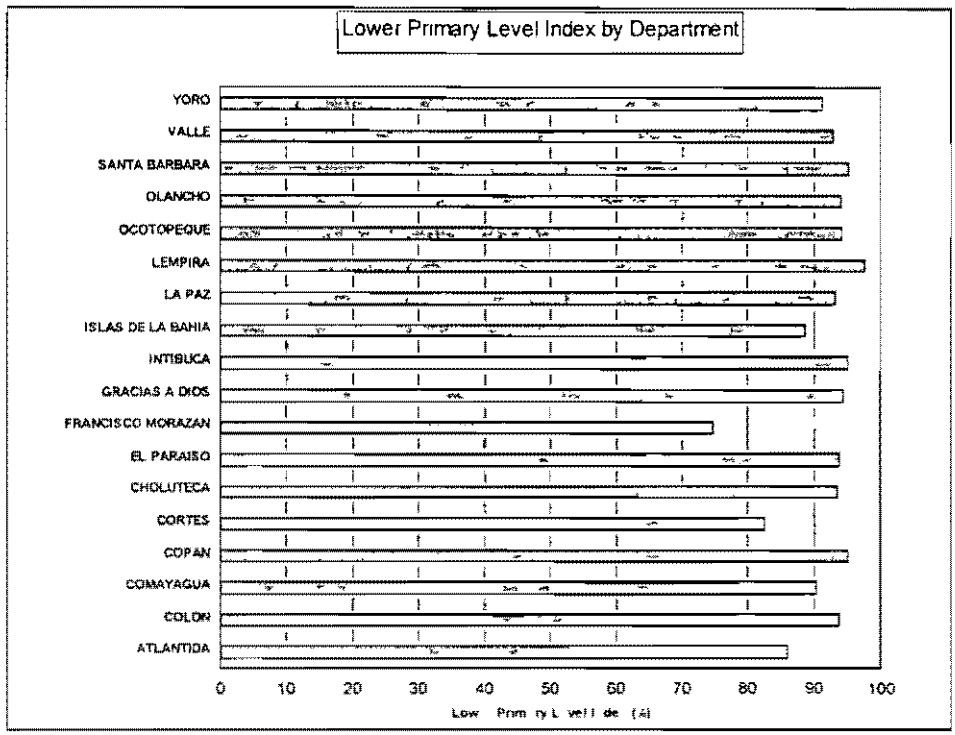
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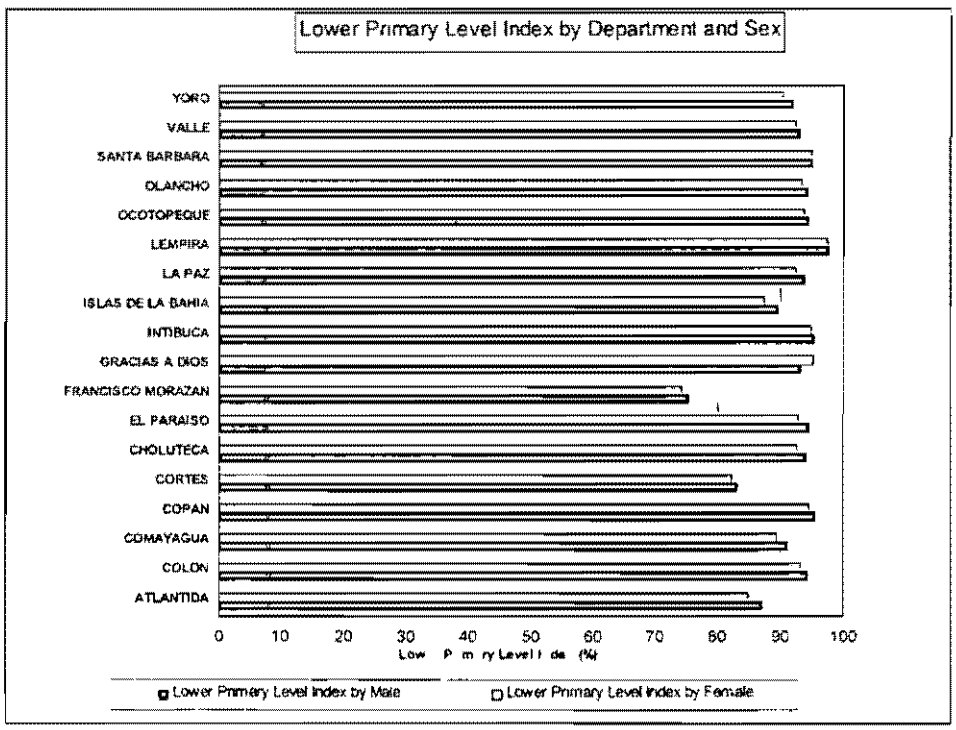
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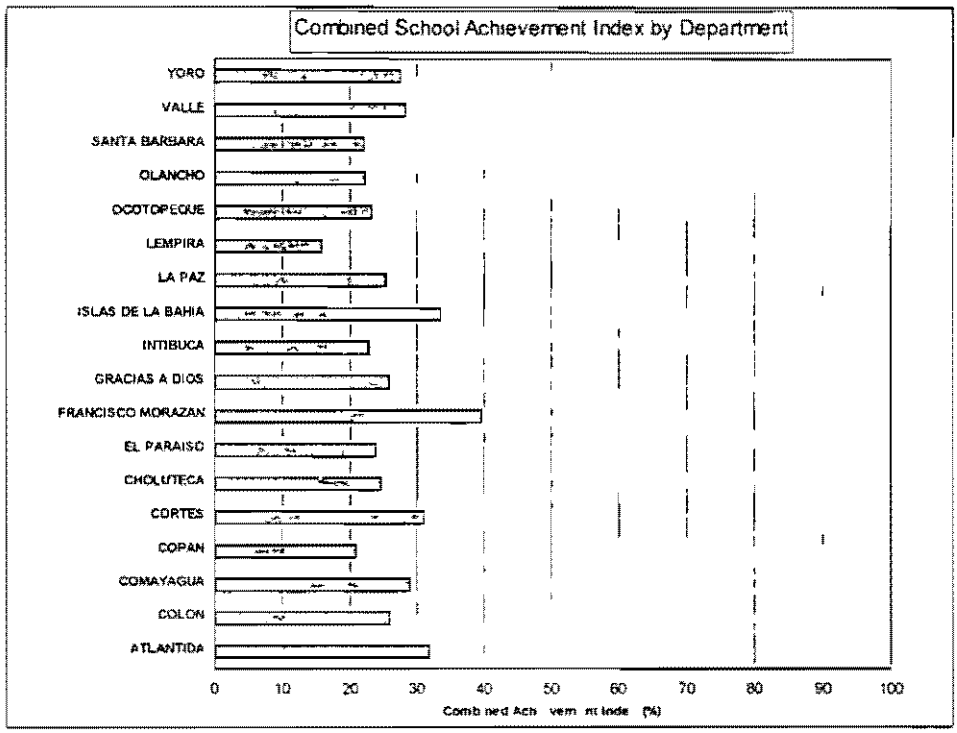
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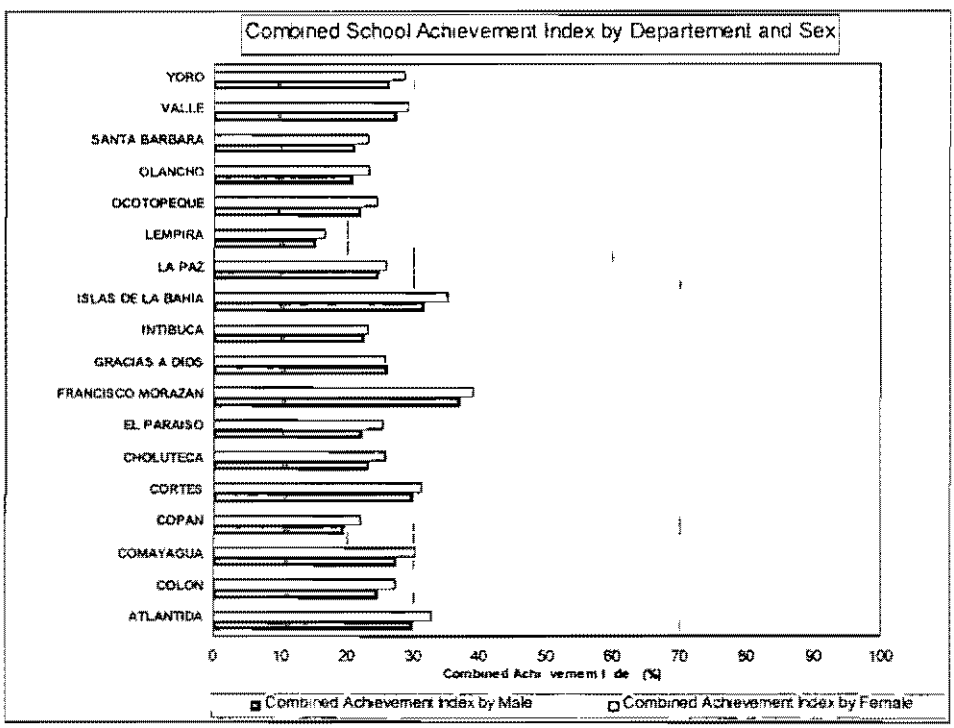
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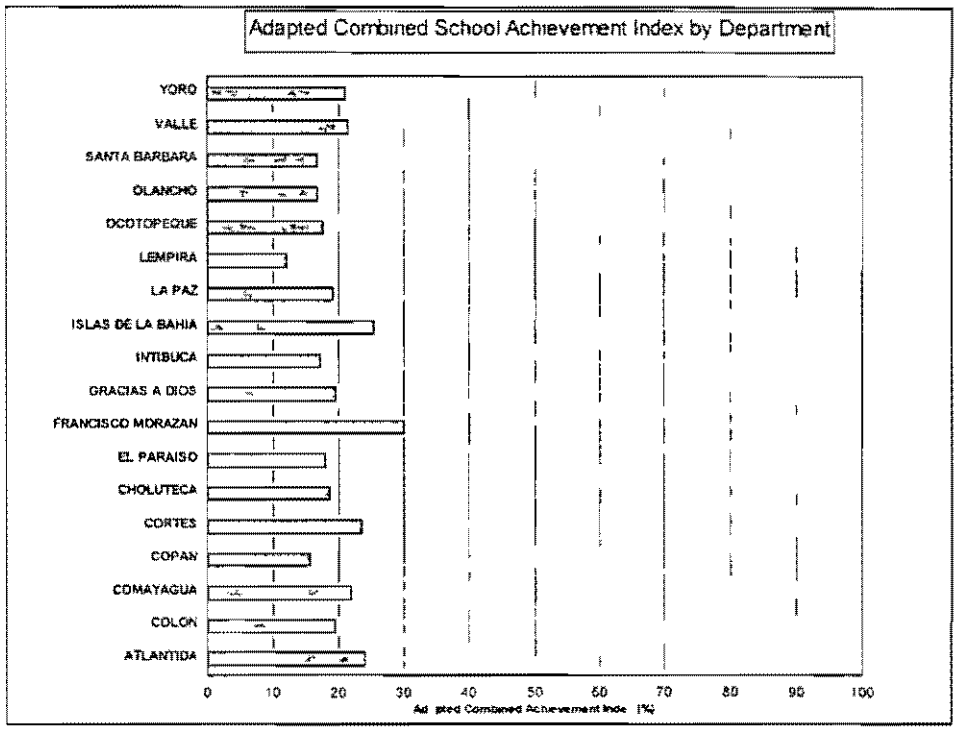
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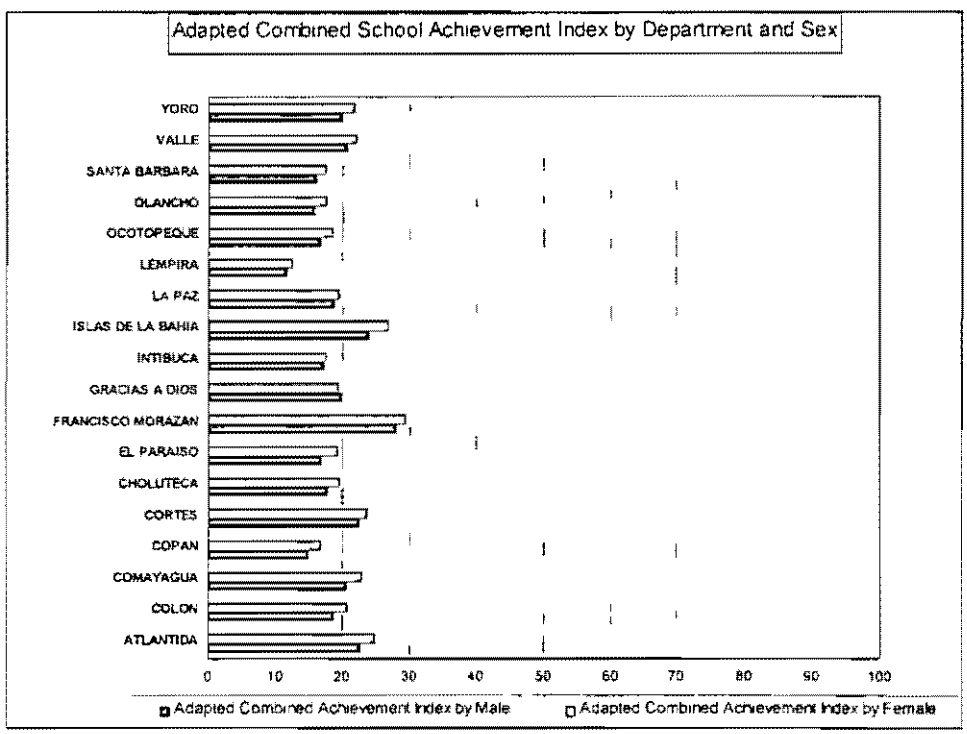
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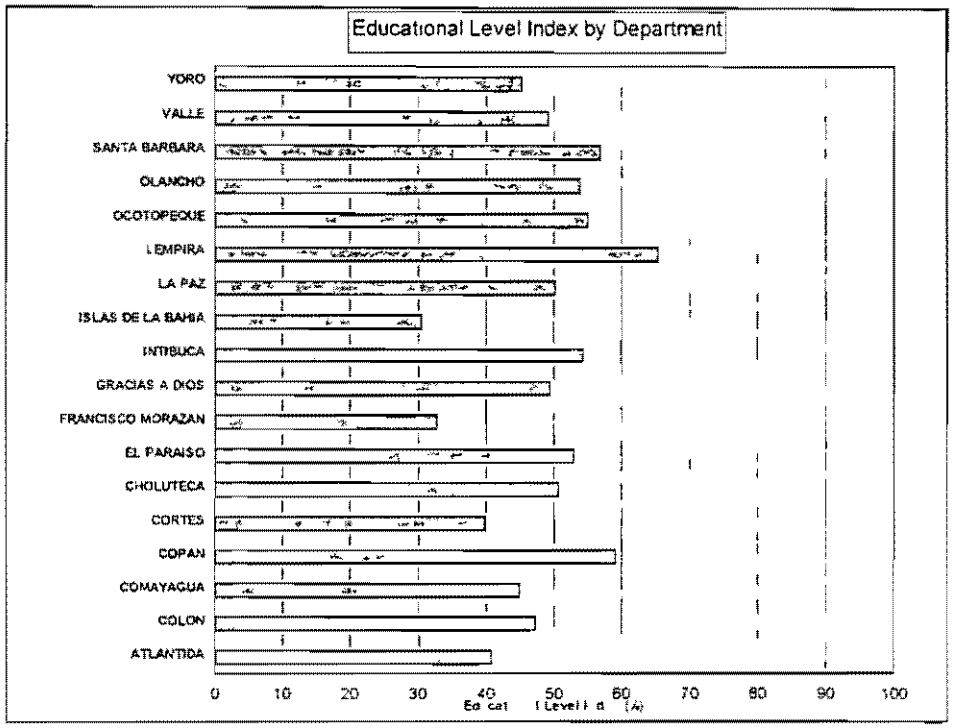
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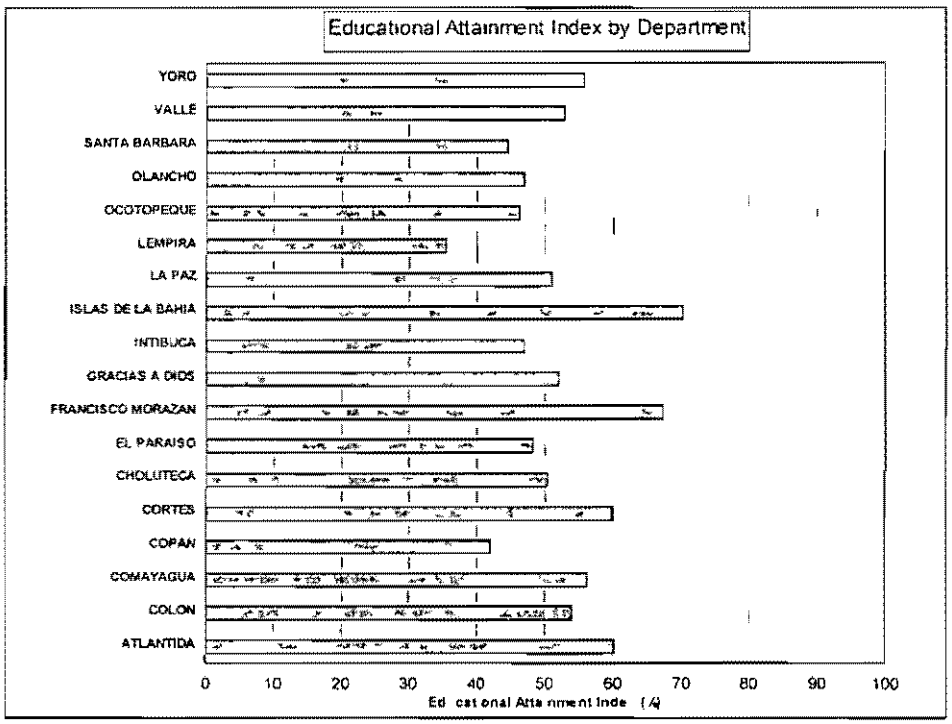
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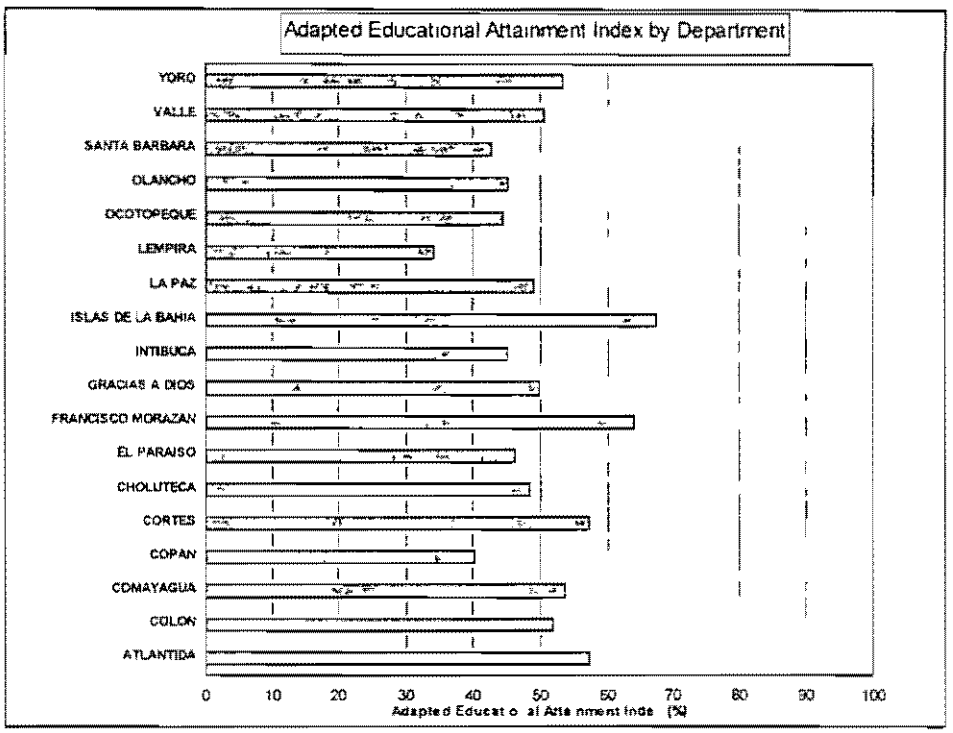
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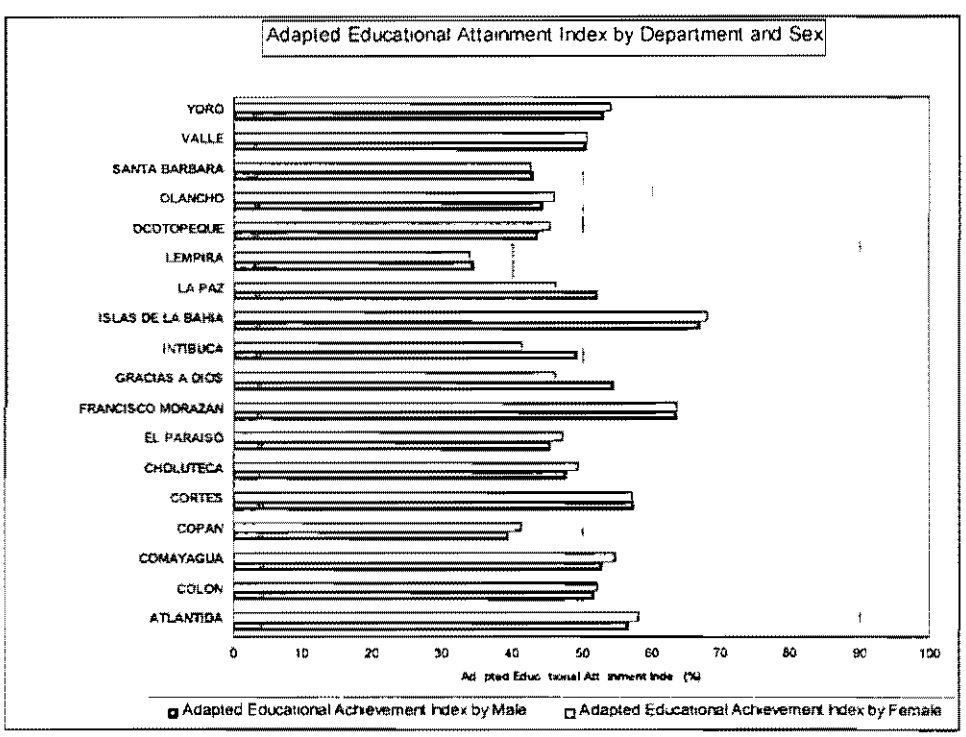
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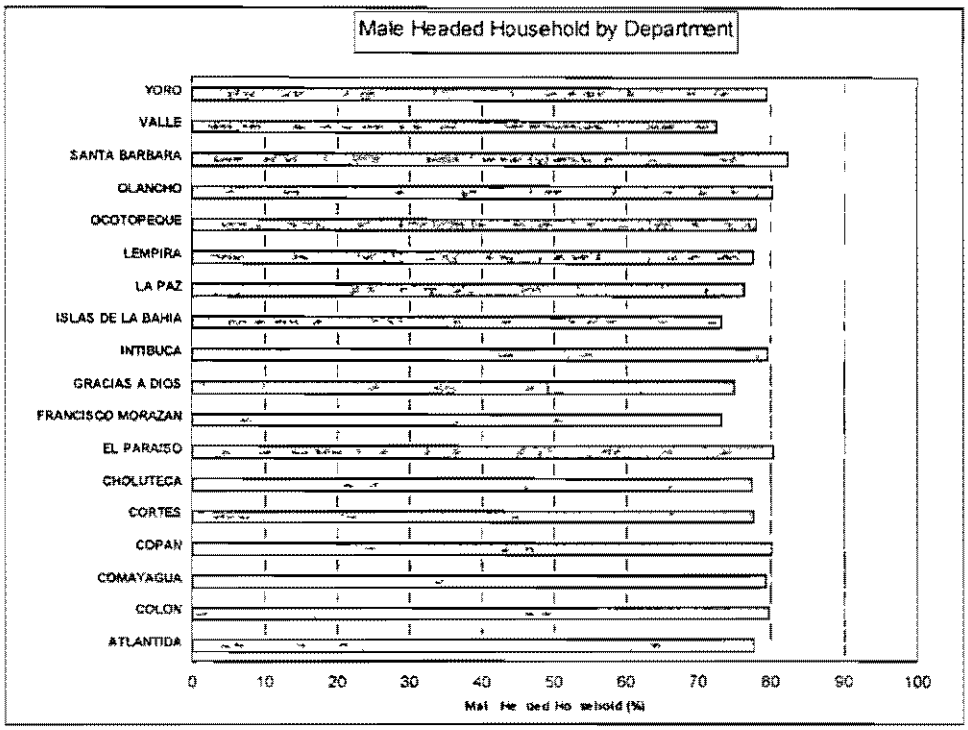
Male Headed Household by Department
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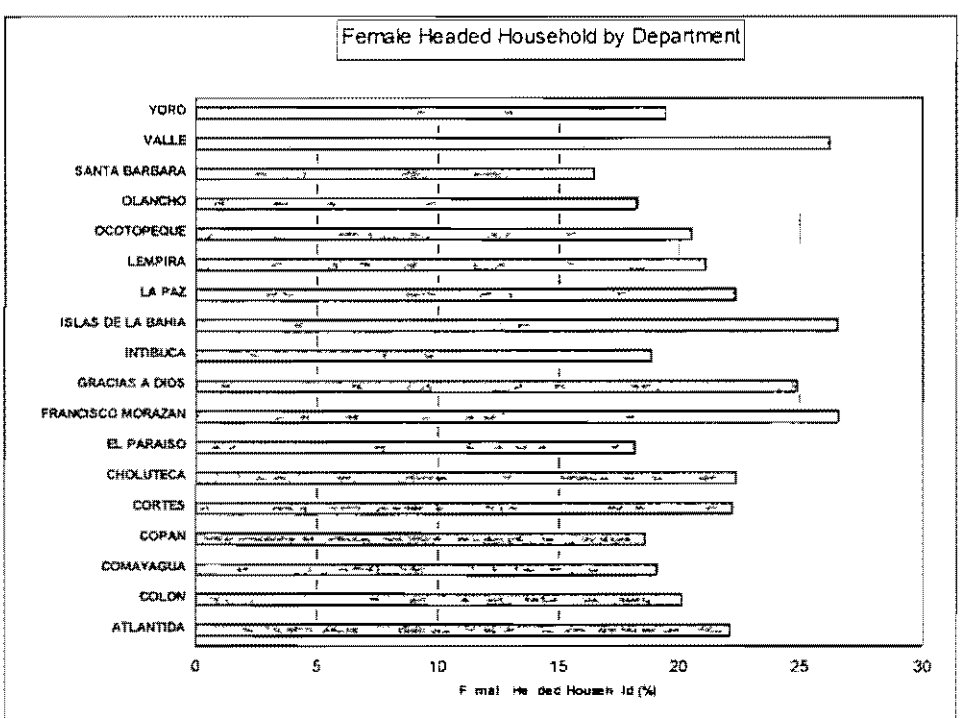
Female Headed Household by Department
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ANNEX 2

1 Processing the Indicator of lack of shelter quality at household level CMV_J

Floor indicator

The norm is established for the floors built with Mud brick Cement brick and Cement floor

MATERIAL TYPE MENTIONED IN THE QUESTIONNAIRE	QUESTIONNAIRE VALUE	SCORE X_J	INDICATOR OF SUCCESS $L\lambda_J = X_J / X^*$	INDICATOR OF LACK $CX_J = 1 \quad L\lambda_J$
Soil	5 – 7	0	0	1
Mud brick Cement brick and Cement floor	1 – 2 3	1*	1	0
Wood and Granite brick	4 6	2	2	1
Inconsistent value	1 0	100	100	100

Roof indicator

The norm is established for the roofs built with Zinc Plate

MATERIAL TYPE	QUESTIONNAIRE VALUE	SCORE X_J	INDICATOR OF SUCCESS $LX_J = X_J / X^*$	INDICATOR OF LACK $CX_J = 1 \quad LX_J$
Residues and others	5 – 6 – 7	0	0	1
Mud/ clay	1	0 5	0 5	0 5
Zinc Plate	3	1*	1	0
Asbestos-cement Concrete	2 – 4	1 5	1 5	0 5
Inconsistent value	-1 – 0	100	100	100

Wall indicator

The norm is established for walls that are built with Cement block Sun dried brick and wooden block

MATERIAL TYPE	QUESTIONN AIRE VALUE	SCORE X_j	INDICATOR OF SUCCESS $LX_j = X_j / X^*$	INDICATOR OF LACK $C\lambda_j = 1 \quad LX_j$
Residues others	8 9	0	0	1
Plaited Cane and Mud	6 7	0 5	0 5	0 5
Cement Block Sun Dried Bricks and Wood	3 – 4 5	1*	1	0
Rock Stone and Clay Bricks	2 1	1 5	1 5	0 5
Inconsistent value	1 0	100	100	100

2 Processing the Household size at household level CEV_j

We consider the lack of kitchen the number of sleeping rooms and its lack rooms that are not used for cooking or sleeping The norm for the number of sleeping rooms (D_j^*) is the function of the number of people (m_j) for the household j is applied as follows

$$D_j^* = m_j / 2\ 5$$

We consider that for 5 people 2 sleeping rooms are necessary

The number of rooms (CMUS*) not used for cooking or sleeping is the function of the number of people per household is applied as follows

$$CMUS_j^* = m_j / 5$$

We consider that for 5 people 1 CMUS is the norm

We consider that each household with more than 1 person must have also 1 kitchen (K*)

In order to process only one indicator which gives the number of rooms per household we consider the CMUS and K in term of equivalent sleeping rooms and weighted as that with one CMUS is worth 1 5 sleeping rooms and one-kitchen is worth 0 5 sleeping rooms

So the norm (DE_j*) per household which integrates these 3 types of rooms is processed as follows

$$DE_j^* = m_j / 2\,5 + 1\,5 * (m_j / 5) + 0\,5 * K_j$$

In function of the number of persons we process the equivalent number of sleeping rooms per household (DE) as follows

$$DE_j = D_j + 1\,5 * CMUS_j + 0\,5 * K_j$$

Where

D_j is the number of sleeping rooms for the household j

K_j is the number of kitchen for the household j

$CMUS_j$ is the number of rooms not used for sleeping or cooking for the household j

Finally we process the indicator of success (AEV_j) and lack (CEV_j) in terms of household size

$$AEV_j = DE_j / DE_j^*$$

$$CEV_j = 1 - AEV_j$$

Where CEV is the indicator of size per household

Water supply

The norm is established for households possessing public or private water supply

TYPE OF WATER SUPPLY	QUESTIONN AIRE VALUE	SCORE X_j	INDICATOR OF SUCCESS $LX_j = X_j / X^*$	INDICATOR OF LACK $CX_j = 1 \quad LX_j$
River Stream and others	6 – 7 – 8 9	0	0	1
Well with manual pump and well with electric pump	3 – 4 5	0 5	0 5	0 5
Public System Pipe and Private System Pipe	1 2	1*	1	0
Inconsistent value	1 0	100	100	100

Water supply installation

The norm is established for households installed with water

TYPE OF WATER INSTALLATION	QUESTIONN AIRE VALUE	SCORE X_j	INDICATOR OF SUCCESS $LX_j = X_j / X^*$	INDICATOR OF LACK $CX_j = 1 \quad LX_j$
Outside the House more than 100 m	4 5	0	0	1
Outside the House less than 100 m	3	0 5	0 5	0 5
Outside the House but within the Property	2	1*	1	0
Within the House	1	1 5	1 5	-0 5
Inconsistent value	1 0	100	100	100

Sanitation

In urban area the norm is established for household possessing with latrines possessing sewerage systems or non (pit latrines) In rural area the norm is established for household possessing hydraulics latrines or holes

Type of latrines installation	Area	Questionnaire value	Score x_j	Indicator of success $Ix_j = x_j / x^*$	Indicator of lack $cx_j = 1 - Ix_j$
Latrine with hydraulics sealing Simple pit latrine and others	Urban	3 4 5	0	0	1
Odorless toilet connected to sewage system and Odorless toilet connected to septic pit	Urban	1 2	1*	1	0
Others	Rural	5	0	0	1
Latrine with hydraulics sealing Simple pit latrine and others	Rural	3 4	1*	1	0
Odorless toilet connected to sewage system and Odorless toilet connected to septic pit	Rural	1 2	1 5	1 5	0 5
Inconsistent value		1 0	100	100	100

Light supply

In urban area the norm is established for households possessing public or private electricity supply In rural area the norm is established for households possessing gas

Type of light supply	Area	Questionnaire value	Score x_j	Indicator of success $ix_j = x_j / x^*$	Indicator of lack $cx_j = 1 \quad ix_j$
Lamps Candles and Others	Urban	4 5	0	0	1
Gas	Urban	3	0 5	0 5	0 5
Public or Private Service Electricity	Urban	1 – 2	1*	1	0
Lamps Candles and Others	Rural	4 – 5	0	0	1
Gas	Rural	3	1*	1	0
Public or Private Service Electricity	Rural	1 – 2	1 5	1 5	0 5
Inconsistent value		1 0	100	100	100

Combustible

The norm is established for households that use volatile gas and electricity

Type of combustible	Questionnaire value	Score x_j	Indicator of success $ix_j = x_j / x^*$	Indicator of lack $cx_j = 1 \quad ix_j$
Firewood and Others	1 5	1	0 33	0 66
Liquid Gas	2	2	0 66	0 33
Volatile Gas and Electricity	3 4	3	1	0
Inconsistent value	1 0	100	100	100

Education

The norm is established for individuals and then per household Three variables are used the number of years passed ($\mathbf{ap}_{ij}$) the school attendance ($\mathbf{as}_{ij}$) and the literacy information ($\mathbf{al}_{ij}$) The norm for the school attendance ($\mathbf{as}_{ij}$*) is manipulated by considering persons of age 7 to 16 years The norm for the literacy ($\mathbf{al}_{ij}$*) is manipulated by considering persons who are able to read and write of age more than 10 years The norm for the number of years passed ($\mathbf{ap}_{ij}$*) in the function of the age as given below

AGE	AP_{ij}*	AS_{ij}* (0 NOT ATTENDING SCHOOL 1 ATTENDING SCHOOL)	AL_{ij}* (0 NOT READ AND WRITE 1 READ AND WRITE)
0 6	0	0	0
7	0	1	0
8	1	1	0
9	2	1	0
10	3	1	1
11	4	1	1
12	5	1	1
13	6	1	1
14	7	1	1
15	8	1	1
16	9	1	1
17 29	10	0	1
30 44	8	0	1
45 98	5	0	1

Then we process the indicator of success in education ($\mathbf{ane_{ij}}$) per individual as follows

$$\mathbf{ane_{ij} = (ap_{ij} + as_{ij}) * al_{ij} / (ap_{ij}^{*} + as_{ij}^{*})}$$

We process finally the indicator of lack of education per individual ($\mathbf{re_{ij}}$) and per household as follows

$$\mathbf{re_{ij} = 1 - ane_{ij}}$$

$$\mathbf{RE_{ij} = re_{ij} / m_j}$$