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# Evaluation of economic activities and poverty in the region close to the National Park of Río Abiseo in Peru

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# Evaluation of economic activities and poverty in the region close to the National Park of Río Abiseo in Peru

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## Abstract

Economic activities and poverty has an indirect influence on natural values. Poverty is in interaction with the economic activities and the socioeconomic structure. This study carried out in order to evaluate poverty and economic activities in the neighbouring regions to the National Park of Río Abiseo in Peru. The subject of the study consists of the 18 districts of provinces Pataz and Bolivar in the state of La Libertad on the western border of the Park. The main economic activities in the region are cattle production, mining and manufacturing.

Due to lacking regional economic accounting variables, the intensity of activities and the change in them are measured in terms of socio-economic variables based on results of two successive censuses of population and agriculture. As the poverty index is used the percentage of persons having at least one unsatisfied basic need (porcentaje de población con necesidades basicas insatisfechas). The poverty index is regressed to the scores of a factor analysis of nine variables representing the socioeconomic structure of the districts and eight variables representing the socioeconomic change. The factors and the interpretation of the factors are: 1. Attractive mining districts; 2. Regressive urban districts; 3. Manufacturing and intensive cattle-grazing districts; 4. Developing rural districts; 5. Districts with developed cattle breeding. The scores of the factors 3, 4 and 5 explain more than 70 percent of the variation in the poverty index. The scores of the factors 3 and 4 are positively correlated with poverty and the scores of the factor 5 is negatively correlated with poverty.

In order to examine the interaction of the poverty and the closeness to the Park, a Box-Whisker-analysis is carried out categorising the observations by means of the dichotomy: border and non-border districts. Six of the districts border on the Park are supposed to have an immediate environmental influence on the Park. It seems that the poverty and the closeness to the Park are positively correlated. The most serious problems of the study are the number of observations and the quality of the data. The results of the study are empirically relevant, although particular stress is put on the technical approach to understand poverty and its covariates in the Andes.

Keywords: economic activities, poverty, census data, factor analysis, Rio Abiseo, Peru

## Introduction

The National Park of Rio Abiseo (the Park) is located in the eastern slope of the Andes in Peru approximately inside the coordinates 77° W - 77°40´W and 7° 30´S - 8°10´S in the state of San Martín. Its total area is 274 520 hectares. The western part of the Park borders on the mountain ridge of the Andes, and its total area is about 174 000 hectares. The Park is a sample of the natural diversity, and its objectives are to protect

- original Andean ecosystems and their processes
- landscape values
- cultural characteristics

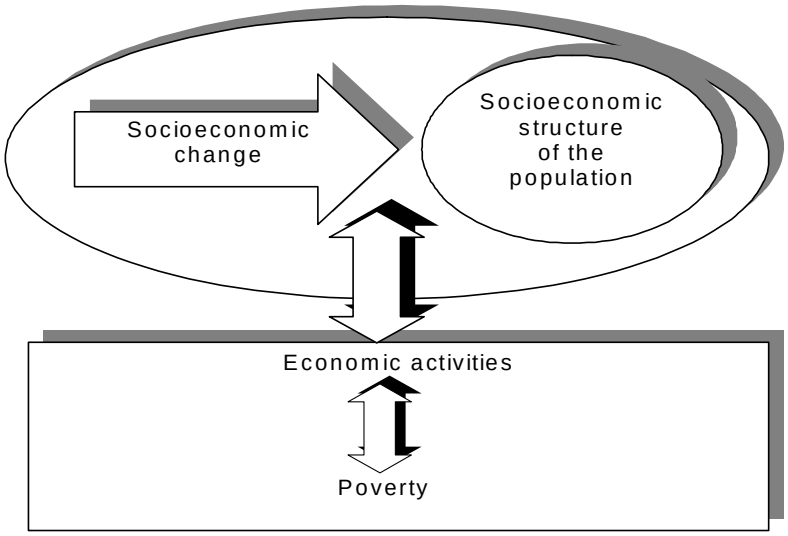
The western part of the Park is under the influence of the human pressure of the economic activities in the neighbouring districts of the provinces Pataz and Bolivar in the state of La Libertad. The main economic activities are agriculture, mining and manufacturing.

Agriculture comprises crop production and cattle breeding. Mining is concentrated on the extraction of gold and minerals associated with gold (PROFONANPE 1999). The evaluation of the environmental pressure is based conceptually on the reasoning that the poverty and the increasing economic activities are increasing the human pressure on the natural values, in general, and in the case of the study on the Park, in particular.

**Problem formulation**

Because there are no direct measurements concerning the environmental effects of the human activities in this region, e.g. in terms of deforestation, soil erosion or loss of biodiversity, the objective of the study is to explore from the available statistical data those factors that can be interpreted to explain poverty in the neighbourhood of the Park., i.e. to find meaningful poverty-dimensions of a multivariate domain of the human activities. First, the domain is defined as a set of variables that can be hypothesized to explain poverty expressed in terms of the percentage of persons having at least one unsatisfied basic need. Next, the principal pressure dimensions are determined on the basis of the co-variation in the chosen set variables. The rationale of the problem formulation is illustrated in Fig. 1.

**Fig.1. Rationale of the problem formulation**




**Data**

The availability and quality of the data is a guiding and restrictive element of the study. The *census data* proved to be the most relevant data depicting economic activity and its long-term changes at the district level, because regional accounting data is not available. The multivariate domain of the human activities is defined by means of census data grouped by economic activities. The data is from two successive censuses from the 1970´s and from the 1990´s (INEI 1982, INEI 1994). The next census was planned to take place in 2005. The data concerning cattle population originates in two successive agricultural censuses from the 1970´s and from the 1990´s (INEI 1972, INEI 1993).

In the earlier censuses the total number of districts, observation units, was 18 and in the latter ones 19. In both cases 6 districts were bordering on the Park. This fact restricts the number of observations to 18. To accomplish variables expressing economic and social dynamics the change variables have been compiled as proportional changes. The compatibility of the successive censuses sets restrictions to the compilation of the change variables. The variables of the censuses of the 1990´s are used as state variables.

Sixteen variables were selected for the analysis. The variables and their sources and definitions are listed in Appendix 1.

**Analysis methods**

The objective is to extract from the census data a small number of dimensions that can be interpreted to explain poverty in the neighbourhood of the Park. For this purpose factor analysis (Cooley and Lohnes, 1962) is utilised. The factors are extracted from a set of state and change variables simultaneously. The factor structure should be robust so that the interpretation is not very sensitive to the set of the chosen primary variables. The factors are composite variables. Factor loadings, correlations between original variables and composite variables, give information to the interpretation of the factors in terms of the original variables. Factor scores give the relative coordinates of the observation units in the factor space. The last step is to explain the variation in the poverty index by means of the factor scores. For this purpose regression analysis are used.

**Results**

The *factor analysis* (Statgraphics) gives five factors having an eigenvalue ≥1. They explain more than 80 percent of the total variation in the data. The procedure and details of the factor analysis are given in Appendix. The varimax-rotated factor loadings are presented in Table 1.

The factors are interpreted as follows

- Factor 1: Attractive mining districts
- Factor 2: Regressive urban districts
- Factor 3: Manufacturing and intensive cattle-grazing districts
- Factor 4: Developing rural districts
- Factor 5: Districts with advanced cattle breeding

**Table 1.** Factor loadings

| Variable | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Est. comm. |
|---|---|---|---|---|---|---|
| Ccows_per_farm | 0.08 | 0.04 | -0.10 | 0.02 | **0.91** | 0.84 |
| Ctotal_number_of_cows | 0.12 | 0.13 | -0.05 | -0.07 | **-0.58** | 0.38 |
| Cpopulation | **0.87** | 0.31 | -0.24 | 0.15 | 0.07 | 0.93 |
| Cec_act_population | **0.95** | 0.02 | -0.22 | 0.03 | -0.01 | 0.96 |
| Cold_population | 0.37 | **0.71** | -0.01 | 0.05 | **0.41** | 0.81 |
| Cyoung_population | **0.76** | 0.26 | **-0.35** | 0.24 | 0.18 | 0.87 |
| Crural_population | **0.57** | -0.06 | **-0.31** | **0.47** | -0.06 | 0.64 |
| Ceducated_people | 0.41 | **-0.45** | 0.03 | **0.65** | 0.20 | 0.84 |
| Sec_act_population | **0.81** | -0.40 | 0.04 | 0.06 | -0.13 | 0.85 |
| Seducated_people | 0.07 | **0.88** | 0.04 | -0.10 | -0.20 | 0.83 |
| Sold_population | -0.31 | -0.20 | 0.16 | **-0.77** | 0.02 | 0.75 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Srural_population | 0.24 | **-0.81** | 0.28 | -0.17 | 0.10 | 0.83 |
| Syoung_population | **-0.52** | 0.01 | -0.21 | **0.75** | 0.17 | 0.90 |
| Scows_per_pasture_area | -0.24 | -0.10 | **0.94** | -0.04 | -0.09 | 0.96 |
| Sagr_people | **-0.64** | -0.14 | 0.12 | -0.29 | -0.27 | 0.61 |
| Smining_people | **0.78** | -0.13 | -0.06 | -0.13 | -0.22 | 0.69 |
| Speople_in_manufacturing | -0.22 | -0.05 | **0.91** | -0.25 | 0.06 | 0.93 |
| Percent of variance | 35.28 | 16.48 | 12.97 | 8.96 | 6.46 | |

C = change variable
S = state variable

Factor 1 “Attractive mining districts” mainly picks up the changes in the total population, in the economic active population, in share of the rural population and in the young population. The share of the population economically active in the mining activities has a high positive loading on this factor. The cross-section shares of the active population in agriculture and of the young population have high negative loadings. The districts getting high scores on this factor are interpreted to be changing into mining areas.

Factor 2 “Regressive urban districts” correlates positively with the change in the share of old people and negatively with the change of the share of population with the highest education. The cross-section share of educated people has a high positive loading on this factor, whereas the respective figure of the rural people has a high negative loading. The districts with high scores on this factor are urban; they have ageing people, and they are less good in attracting educated people.

Factor 3 “Manufacturing and intensive cattle grazing districts” shows decrease in the share of young and rural population. The cross-section share of the population in manufacturing and the density of cows per area of pasture have the most significant positive loadings on this factor. This reveals integration between the cattle breeding and manufacturing in the districts with high scores on this factor.

Factor 4 “Developing rural districts” shows increase in the change of the share of rural and population with highest education. The cross-section of the share of young people has a high positive loading, and the respective share of old people a high negative loading on this factor. It is notable that the change of the total population has an only slightly positive loading.

Factor 5 “Districts with advanced cattle breeding” shows a high negative loading in the change of the total number of cows but a high positive loading in the change of number of cows per farm, indicating specialisation and technological development in cattle breeding. This is possible in the case of introduction of more productive cattle and cattle breeding methods (Vehkamäki and Bäckman, 2006). The development is slightly associated with ageing population.

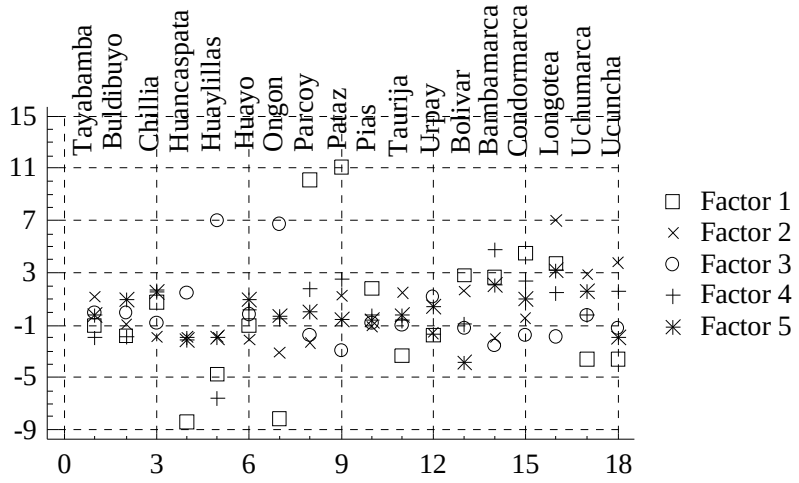



**Figure 2.** Factor scores by districts

The scores from the factor 1 and 3 distinguish clearly by the different districts (Figure 2.) Parcoy and Pataz have high scores on the factor 1 while Huaylillas and Ongon gets high scores on the factor 3.

**Explanation of poverty**

**Table 3.** Correlations of the factor scores and poverty index

| | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Poverty index |
|---|---|---|---|---|---|
| Factor 1 | 0.15<br>*0.12* | **-0.69**<br>***-0.81*** | **0.58**<br>***0.65*** | 0.22<br>*0.32* | 0.28<br>*0.24* |
| Factor 2 | | -0.42<br>*-0.38* | 0.17<br>*-0.02* | 0.13<br>*0.00* | -0.30<br>*-0.36* |
| Factor 3 | | | **-0.73**<br>***-0.81*** | -0.30<br>*-0.31* | -0.10<br>*-0.26* |
| Factor 4 | | | | **0.47**<br>***0.49*** | **0.50**<br>*0.39* |
| Factor 5 | | | | | -0.09<br>*-0.05* |

Regular: Pearson product moment correlation
Italics: Spearman rank correlation
Bold : Statistically significant at the 95 % confidence level

Table 3 shows the correlation and rank correlation between the factor scores. Factor 1 has significant (95 % level) negative correlation with factor 3 and positive correlation with factor 4. Factor 3 has significant negative correlation with factor3. Factors 4 and 5 have positive significant correlation. The factor scores are further visualised by the box-whisker plots in Figure 4. In this figure the differences between border and non-border districts are compared. The largest differences between border and non-border districts are shown for factor 1 the active mining and factor 3 manufacturing and intensive cattle grazing districts.

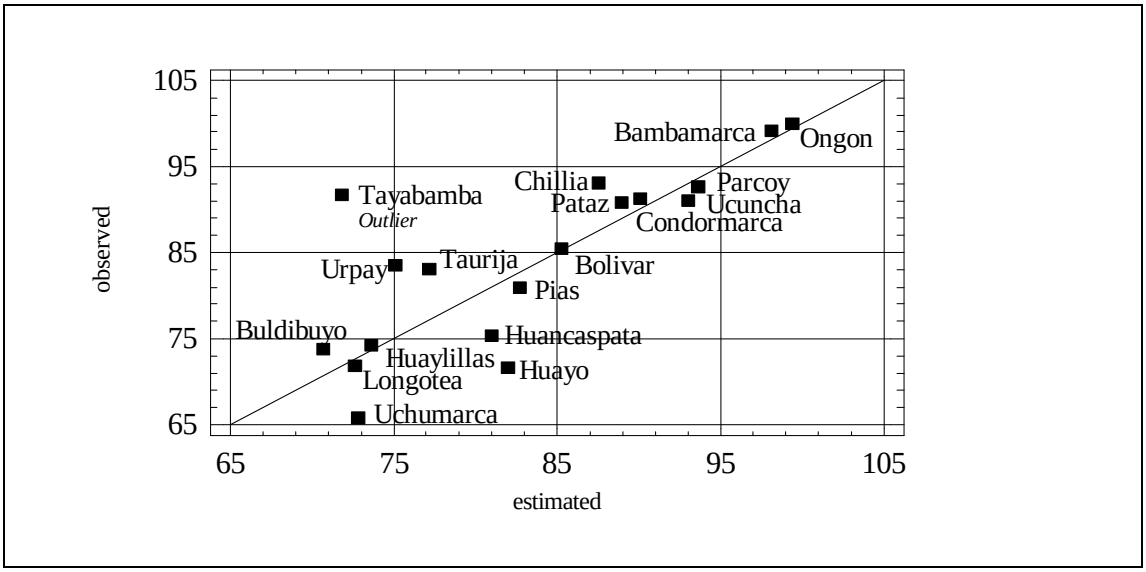
The percentage of persons having at least one unsatisfied basic need (porcentaje de población con necesidades basicas insatisfechas (INEI, 1994)) is used as a poverty index. Co-variation of the poverty index with the factor scores is examined by means of regression analysis (cf

Table 2A in Appendix). The regression is calculated despite there is correlation between the factors (Table 3). The regression is merely to illustrate the relations. The poverty index explained by the factor scores (Eq.1, t–values of the coefficients in brackets) shows that when poverty increases factors 3 and 4 increases while factor 5 decreases. The district Tayabamba is taken up as an outlier (Figure 4.). The interpretation of this is that the manufacturing and intensive cattle grazing districts and the demographically expansive districts have more poverty while the districts with specialising cattle breeding have less poverty.

$$Poverty\ \ index = 83.12[56.2] + 2.84[3.49] \cdot Factor\ \ score\ 3 + 5.66[5.68] \cdot Factor\ \ score\ 4 - 2.90[-3.0] \cdot Factor\ \ score\ 5 \qquad \text{(Eq.1)}$$

Figure 3 shows the relation between the observed poverty indicator and by the regression model estimated poverty. Ongon and Bambamarca have the highest values of the poverty indicator, and Uchumarca the lowest. The regression shows a rather good explanation, 72 percent of the total variation in the poverty index. With inclusion of a dummy variable for the border regions the explanation increases slightly, the border districts show a higher value for the poverty index.

**Figure 3.** Explanation of the poverty index by the scores of the factors 3, 4 and 5




**Comparison of the border and non-border districts**

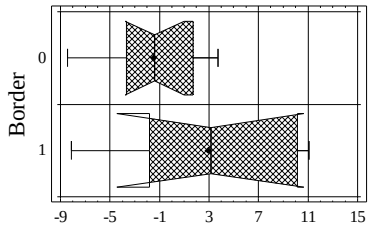
The border districts seem to

- be more attractive mining districts
- be less regressive (more expanding) urban districts
- be demographically more expansive districts
- and to have larger poverty indices

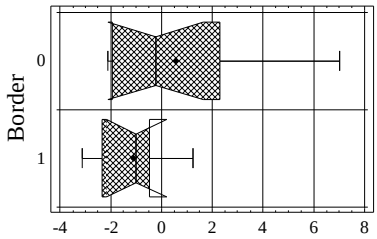
than the non-border districts (cf. Figure 4.). That means that mining, urbanisation and population are increasing in the neighbourhood of the National Park of Rio Abiseo, at least in relative terms. Whereas the non-border districts seem to have higher scores on the factor "Manufacturing and intensive cattle grazing district" than the border districts. The variation among the non-border districts makes up the factor 5. The border districts are similar and indifferent with respect to this factor having factor scores close to zero.

**Figure 4**. Comparison of border (1) and non-border (0) districts: Box-Whisker plots of factor scores and poverty index

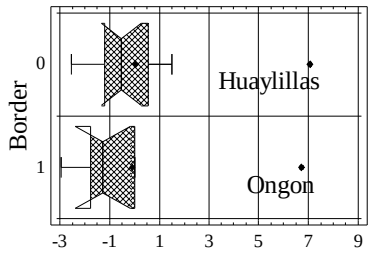
1. Attractive mining districts



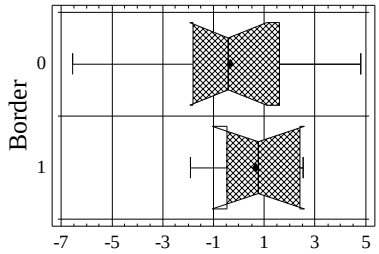

2. Regressive urban districts



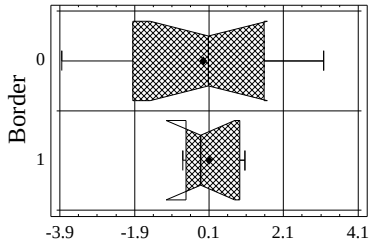

3. Manufacturing and intensive cattle grazing district



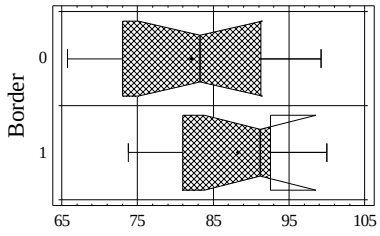

4. Demographically expansive districts




5. Districts with advanced cattle breeding




6. Poverty index




## Conclusions

Poverty and backward technology seem to constitute a vicious circle, an interactive loop with positive feedback. The advanced cattle breeding is an economic tool for breaking this circle, but it is not characteristic of the border districts. Cattle breeding integrated with manufacture in the form of intensive grazing (animals per hectare) constitutes a bigger indirect risk to the environment than the advanced cattle breeding. Interactively, the geographical position, especially the altitude, the mineral deposits, pasture lands, etc determine how economic activities are located.

Decreasing poverty without jeopardising environment is a challenge for the western border area of Río Abiseo. Utilisation of environment-friendly technological innovations requires external inputs. The great diversity in the regions, however, shows that several achievements are attainable. Further information from location is needed to show causal relations between certain economic activities and the environment.

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## Appendix

**Table A1.** List of variables

| Name | Source | Definition |
|---|---|---|
| Sagr_ people | INEI 1972,1995 | Change in share of population employed by agriculture |
| Ccows_per_ farm | INEI 1972,1995 | Change in number of cows per farm |
| Ctotal_number_ of_cows | INEI 1972,1995 | Change in total number of cows |
| Cpopulation | INEI 1981, 1993 | Change in total population |
| Cec_act_ population | INEI 1981, 1993 | Change in share of economic active population |
| Cold_ population | INEI 1981, 1993 | Change in share of population older than 65 years |
| Cyoung_ population | INEI 1981, 1993 | Change in share of population younger than 6 years |
| Crural_ population | INEI 1981, 1993 | Change in share of population in rural area |
| Ceducated_ people | INEI 1981, 1993 | Change in share of population with highest education |
| Sland_area_ for_cereals | INEI 1995 | Share of agricultural land used for cereals |
| Sec_act_ population | INEI 1994 | Share of economic active population |
| Sagr_ people | INEI 1994 | Share of economic active population employed in agriculture |
| Smining_ people | INEI 1994 | Share of economic active population employed in mining sector |
| Seducated_ people | INEI 1994 | Share of economic active population with highest education |
| Speople_in_ manufacturing | INEI 1994 | Share of economic active population employed in manufacturing |
| Sold_population | INEI 1994 | Share of population older than 65 years |
| Srural_ population | INEI 1994 | Share of population living in rural areas |
| Syoung_ population | INEI 1994 | Share of population younger than 6 years |
| Scows_per_ pasture_area | INEI 1995 | Number of cows per pasture area |
| Scows_per_ population | INEI 1995 | Number of cows per population |
| Nbip | INEI 1994 | Poverty index = Percentage of persons having at least one unsatisfied basic need |

**Table A2.** Results of the multiple regression analysis:
Explanation of the poverty index (Nbip) by factor scores

| Parameter | Estimate | Standard error | T-statistic | P-Value |
|---|---|---|---|---|
| Constant | 83.12 | 1.48 | 56.23 | 0.00 |
| Factor score 3 | 2.84 | 0.81 | 3.49 | 0.00 |
| Factor score 4 | 5.66 | 1.00 | 5.68 | 0.00 |
| Factor score 5 | -2.90 | 0.98 | -2.97 | 0.01 |

| Analysis of Variance | | | | | |
|---|---|---|---|---|---|
| Source | Sum of squares | Df | Mean Square | F-Ratio | P-Value |
| Model | 1234.62 | 3 | 411.54 | 11.15 | 0.0007 |
| Residual | 479.96 | 13 | 36.92 | | |
| Total (Corr.) | 1714.58 | 16 | | | |
| R-squared | 72.01 | | | | |

Figure A1.

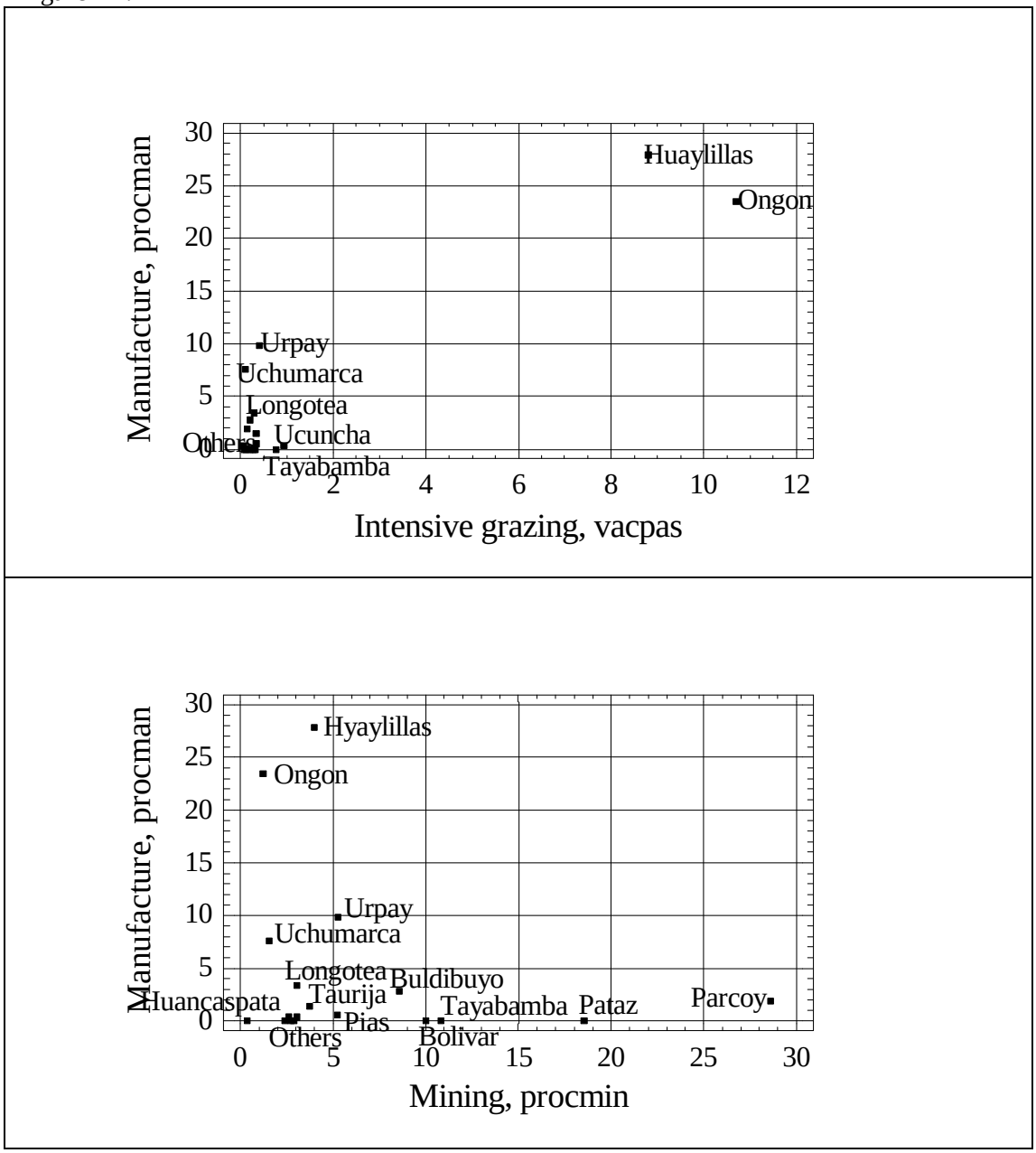
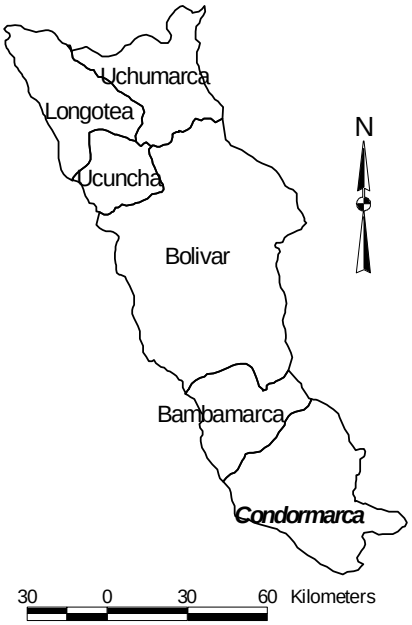
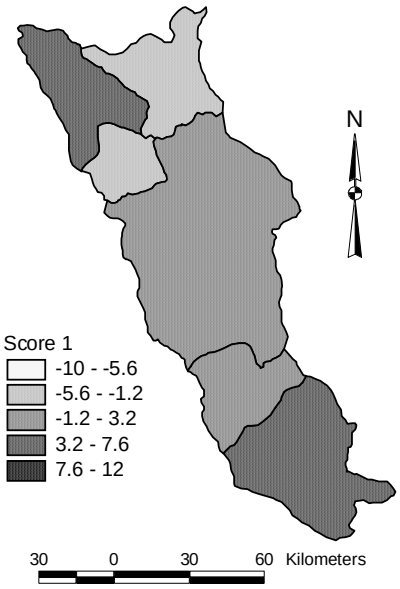
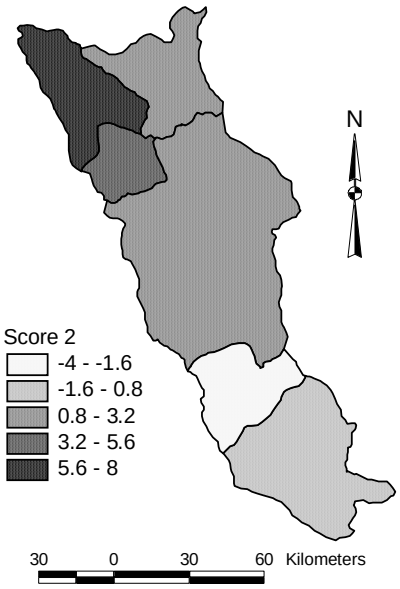
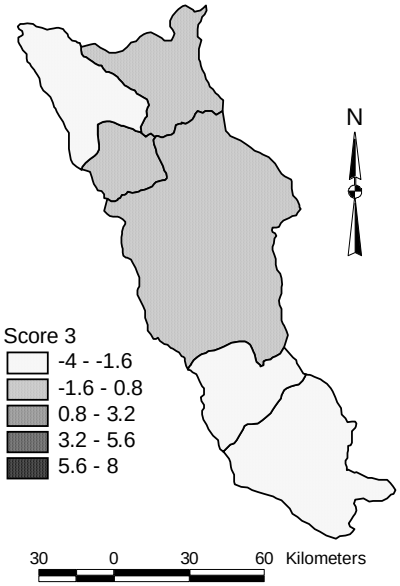


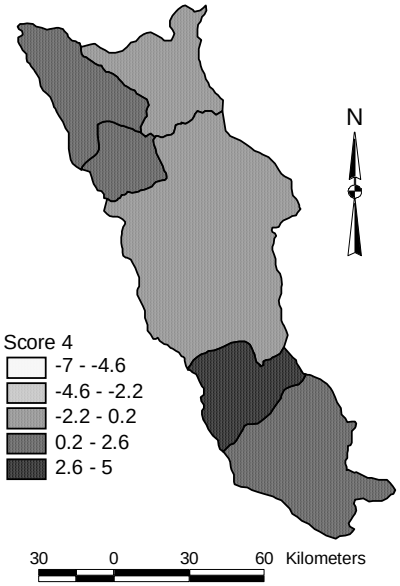

**Figure A2. District of Bolivar**


Uchumarca
Longotea
Ucuncha
Bolivar
Bambamarca
Condormarca
N
30 0 30 60 Kilometers


N
Score 1
-10 - -5.6
-5.6 - -1.2
-1.2 - 3.2
3.2 - 7.6
7.6 - 12
30 0 30 60 Kilometers


N
Score 2
-4 - -1.6
-1.6 - 0.8
0.8 - 3.2
3.2 - 5.6
5.6 - 8
30 0 30 60 Kilometers


N
Score 3
-4 - -1.6
-1.6 - 0.8
0.8 - 3.2
3.2 - 5.6
5.6 - 8
30 0 30 60 Kilometers


N
Score 4
-7 - -4.6
-4.6 - -2.2
-2.2 - 0.2
0.2 - 2.6
2.6 - 5
30 0 30 60 Kilometers

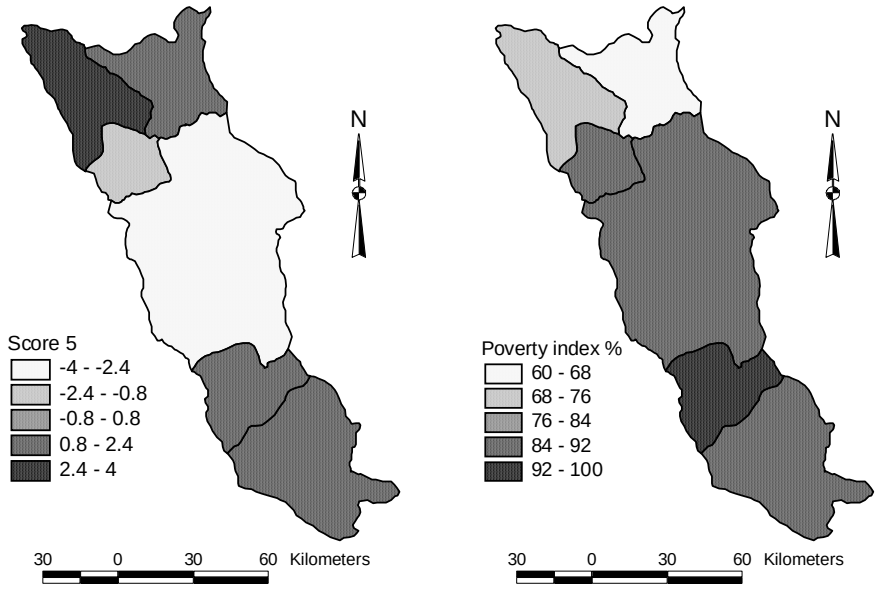
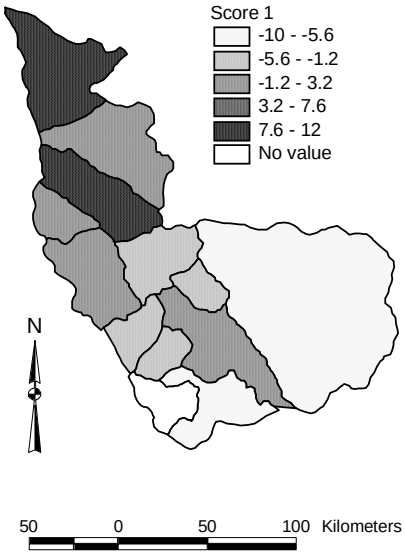
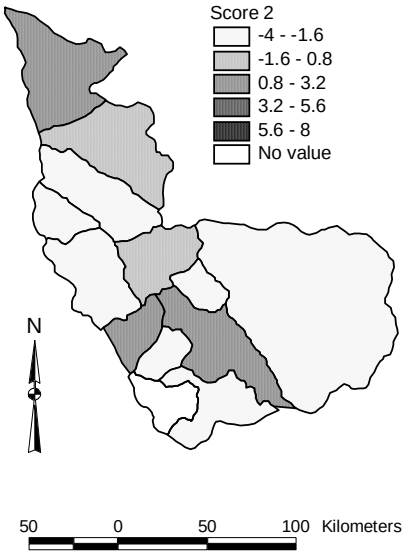
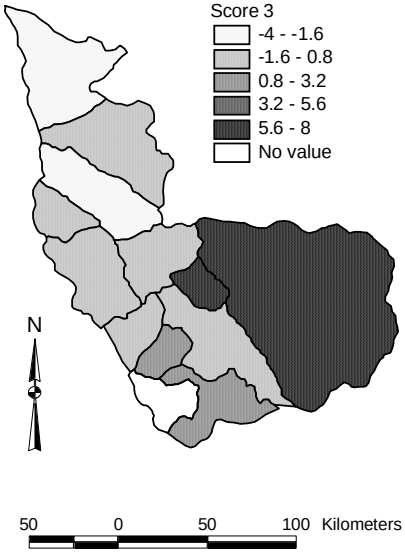


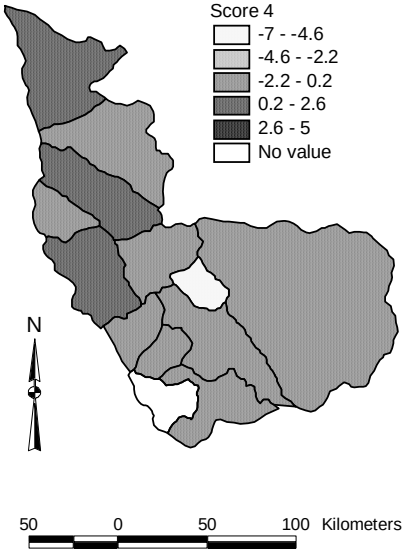

**Figure A3. District of Pataz**

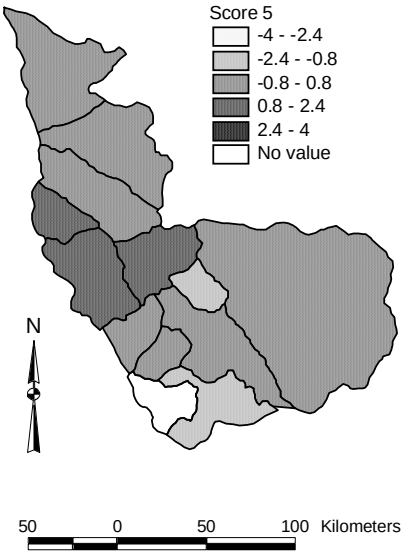


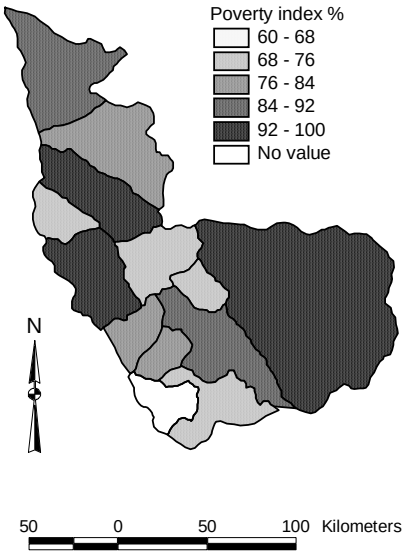

Score 1
-10 - -5.6
-5.6 - -1.2
-1.2 - 3.2
3.2 - 7.6
7.6 - 12
No value
N
50 0 50 100 Kilometers


Score 2
-4 - -1.6
-1.6 - 0.8
0.8 - 3.2
3.2 - 5.6
5.6 - 8
No value
N
50 0 50 100 Kilometers


Score 3
-4 - -1.6
-1.6 - 0.8
0.8 - 3.2
3.2 - 5.6
5.6 - 8
No value
N
50 0 50 100 Kilometers


Score 4
-7 - -4.6
-4.6 - -2.2
-2.2 - 0.2
0.2 - 2.6
2.6 - 5
No value
N
50 0 50 100 Kilometers


Score 5
-4 - -2.4
-2.4 - -0.8
-0.8 - 0.8
0.8 - 2.4
2.4 - 4
No value
N
50 0 50 100 Kilometers


Poverty index %
60 - 68
68 - 76
76 - 84
84 - 92
92 - 100
No value
N
50 0 50 100 Kilometers

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