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**Rural Poverty and Soil Degradation: Some Evidences from a Land Reform Settlement in the Brazilian State of Goiás**

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**Abstract**

In different continents there is a paradigm of a vicious circle of poverty and natural resource degradation. However, there are cases where this may not be true. Thus, the central objective of this study was to analyze the relationship between rural poverty and soil degradation in land reform settlement in the Brazilian Center West region. Therefore, farmers were interviewed and data was analyzed through an econometric analysis of the probit model. Our hypothesis was that environmental degradation can worsen the rural poverty in the farm enterprises. The binary and dependent variable was the adoption of natural resource saving practices like agroforestry systems and crop rotation. As independent variables that explain the probability to occur ( $y=1$  or  $y=0$ ) we considered the total (farm and nonfarm) income, the total herd size of cattle, the land ownership and the education level of farmers (years of school visit). We expected positive signs for all estimated coefficients in the probit model, i.e. the higher the values of independent variables the more likely the conservation practices to be adopted. The estimated model was significant at 5% level. The independent variables explain 50.41% of the variation in the probability of adoption of crop rotation in the farms. Three of the independent variables had negative signs: total income, herd size and land ownership, meaning that increasing the values of those variables decrease the probability of the adoption of conservation practices. This result evidences an opposite relationship between rural poverty and environmental degradation. On the other side, the education level of farmers was positively related to the likeness of adoption of soil conservation practices. Thus, there was no relationship between rural poverty and soil degradation. However, there is a clear positive relationship between the education level of farmers and the likeness of adoption of natural resource conservation practices.

**Keywords:** soil erosion, land reform, crop rotation, agroforestry.

**Introduction**

In different continents there is a paradigm that rural poverty and environmental degradation are directly correlated, forming a vicious circle (HOLDEN et al., 2005; HOPKINS et al., 1999; KHATUN,

2009; OLUOKO-ODINGO, 2009; VOSTI et al., 2002). Some authors however described situations where no direct correlation between poverty and environmental degradation could be found. Studying the relationships between rural poverty and environmental degradation in Machadinho and Maximiliano de Almeida, in the state of Rio Grande do Sul, Brazil, WAQUIL et al. (2004) refuted the hypothesis that rural poverty and environmental degradation are directly correlated, forming a vicious circle. Thus, the central objective of this study was to analyze the relationship between rural poverty and soil degradation in land reform settlement in the Brazilian Center West region. Our hypothesis was that there would be a clear and direct relationship between poverty and environmental degradation, characterizing a vicious circle.

## Background

The state of Goiás represents typical ‘Cerrado’ vegetation. ‘Caiapônia’ is one of the larger municipalities, located in the western region of Goiás. The study area is represented by the land reform settlement ‘Cachoeira Bonita’, in ‘Caiapônia’ municipality. The settlement has 60 families in total.

A sample of 28 farmers were selected and interviewed with a structured questionnaire. The data was analyzed through an econometric analysis of the probit model using GRETL 1.7.8 (COTTRELL & LUCCHETTI, 2008).

Our hypothesis was that environmental degradation can worsen the rural poverty in the farm enterprises. The binary and dependent variable was the adoption of crop rotation (AM) as soil conserving practice. As independent variables that explain the probability to occur ( $y=1$  or  $y=0$ ) we considered the total (agricultural and non agricultural) income, the total herd size of cattle, the land ownership and the education level of farmers (years of school attendance). Table 1 shows the main coefficient for each variable.

Table 1: Coefficients for tested variables.

|              | Variables |          |           |          |
|--------------|-----------|----------|-----------|----------|
|              | B         | E        | TP        | RT       |
| Mean         | 24.36842  | 5.684211 | 34.37526  | 3872.943 |
| Median       | 22.00000  | 6.000000 | 34.00000  | 3000.000 |
| Maximum      | 68.00000  | 12.00000 | 42.00000  | 13831.60 |
| Minimum      | 0.000000  | 0.000000 | 24.20000  | 793.3333 |
| Std. Dev.    | 17.62010  | 3.888053 | 4.336781  | 3121.340 |
| Skewness     | 0.696743  | 0.250919 | -0.608381 | 1.706677 |
| Kurtosis     | 3.172928  | 2.190807 | 3.324463  | 6.373304 |
| Jarque-Bera  | 1.560934  | 0.717752 | 1.255413  | 18.23222 |
| Probability  | 0.458192  | 0.698461 | 0.533815  | 0.000110 |
| Sum          | 463.0000  | 108.0000 | 653.1300  | 73585.91 |
| Sum Sq. Dev. | 5588.421  | 272.1053 | 338.5381  | 1.75E+08 |

B= Herd size (number of cattle heads)

E = Education level (years of school attendance)

TP = Farm size (hectares)

RT = Total income (includes farm and non-farm income)

We expected positive signs for all estimated coefficients in the probit model, i.e. the higher the values of independent variables the more likely the conservation practice (crop rotation) to be adopted.

## Results

The estimated model was significant, since the maximum likelihood estimation was 13.25170 with a p-value of 0.010109 at 5% significance level. The independent variables explain 50.4117% (McFadden R-squared) of the variation in the probability of adoption of crop rotation in the farms (Table 2). Three of the independent variables had negative signs: total income, herd size and land ownership, meaning that increasing the values of those variables decrease the probability of the adoption of conservation practices. This result evidences an opposite relationship between rural poverty and environmental degradation in the studied land reform settlement.

Table 2: Statistical output for ML – Binary Probit (Quadratic hill climbing) for dependent variable AM.

| Variable              | Coefficient | Std. Error            | z-Statistic | Prob.     |
|-----------------------|-------------|-----------------------|-------------|-----------|
| C                     | 17.11650    | 12.90188              | 1.326668    | 0.1846    |
| TP                    | -0.449152   | 0.351229              | -1.278800   | 0.2010    |
| B                     | -0.135551   | 0.085713              | -1.581440   | 0.1138    |
| E                     | 0.259108    | 0.162302              | 1.596454    | 0.1104    |
| RT                    | -9.27E-05   | 0.000127              | -0.728339   | 0.4664    |
| Mean dependent var    | 0.473684    | S.D. dependent var    |             | 0.512989  |
| S.E. of regression    | 0.399247    | Akaike info criterion |             | 1.212381  |
| Sum squared resid     | 2.231571    | Schwarz criterion     |             | 1.460918  |
| Log likelihood        | -6.517620   | Hannan-Quinn criter.  |             | 1.254443  |
| Restr. log likelihood | -13.14347   | Avg. log likelihood   |             | -0.343033 |
| LR statistic (4 df)   | 13.25170    | McFadden R-squared    |             | 0.504117  |
| Probability(LR stat)  | 0.010109    |                       |             |           |
| Obs with Dep=0        | 15          | Total obs             |             | 28        |
| Obs with Dep=1        | 13          |                       |             |           |

AM = crop rotation (Y = 1, farmers adopt crop rotation, and for Y= 0, farmers do not adopt crop rotation).

On the other side, the independent variable ‘education level of farmers’ showed a positive sign in its estimated coefficient and was statistically significant at 20% level. Thus, the education level of farmers was positively related to the likeness of adoption of soil conservation practices.

Thus, in the case of the analyzed settlement in Brazilian state of Goiás, the hypothesis of relationship between rural poverty and soil degradation has been rejected, since the signs of the results found for the three variables were opposite to what was expected according to the economic theory of poverty. It is important to consider, that the studied variables are associated with an increase in income and an improvement of future perspectives in farming activities. Therefore, the expectation was that the opposite would occur, since improved livelihoods would lead to a reduction of soil degradation and the adoption of soil conservation practices.

However, there is a clear positive relationship between the education level of farmers and the likeness of adoption of soil conservation practices. Thus, improving farmer's education increases the probability of adoption of soil conservation practices.

So, the hypothesis of vicious circle, based on direct correlation between poverty and environmental degradation, has to be refuted for case of the land reform settlement in Goiás state, Brazil. These results are in line with those obtained by WAQUIL et al. (2004), challenging the mainstream regarding poverty and environmental degradation studies.

## Conclusions

There was no direct correlation between poverty and environmental degradation in the studied land reform settlement of Cachoeira Bonita, Goiás state, Brazil. Higher education levels are likely to increase the adoption of soil conservation practices, like crop rotation, in land reform settlements in Brazilian state of Goiás.

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