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EDUCATION FOR RURAL PEOPLE: A NEGLECTED KEY TO FOOD SECURITY

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EDUCATION FOR RURAL PEOPLE: A NEGLECTED KEY TO FOOD SECURITY

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Abstract. *In the world there are approximately 800 million people who live in condition of food insecurity and illiteracy. This paper shows that education is a key to food security for rural populations in developing countries. Attention is drawn to rural areas because they are traditionally more disadvantaged by national educational policies. The theoretical foundation of this research is that being educated improves rural people's capacity to diversify assets and activities, increase productivity and income, foster resilience and competitiveness, access information on health and sanitation, strengthen social cohesion and participation: these are all essential elements to ensure food security in the long run.*

The main findings of this research are the following: first, the association between food insecurity and primary education is very high, while it decreases progressively with basic, secondary, and tertiary education. Such a two-way relationship is expressed through graphical tools and correlation coefficients. Second, the econometric model shows that primary education is a crucial element to reduce food insecurity in rural areas, even when compared to other factors such as access to water, health, and sanitation. Concluding from this model, doubling access to primary education causes a decrease of food insecurity by approximately 20% or 24% depending on the definition of food insecurity and its measurement. Finally, since in most of developing countries the majority of people live in rural areas, and since it is in these areas that the largest proportion of world poverty and hunger exists, we can conclude that education for rural people is a relevant tool for promoting overall national food security.

Keywords: Education, Food Security, Human Development, Cross-Sectional Models.

JEL Codes: I2, Q18, O15, C31.

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International Conference of the Human Development and Capability Association (HDCA), held in Groningen in August 2007.

FAO Disclaimer

List of Abbreviations

DHS	Demographic and Health Surveys
EFA	Education for All
ERP	Education for Rural People
FAO	Food and Agriculture Organization of the United Nations
HFI	Household Food Insecurity
HNP	Health, Nutrition and Population
IFAD	International Fund for Agricultural Development
ISCED	International Standard Classification of Education
MDGs	Millennium Development Goals
OLS	Ordinary Least Squares
PRSPs	Poverty Reduction Strategy Papers
SD	Standard deviation
SOFI	State of Food Insecurity
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

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1. Introduction

In the world there are approximately 800 million people who live in condition of food and educational deprivations. The objective of this paper is to assess the capacity of educational variables to explain the phenomenon “food security” at household level. According to the definition given at the 1996 World Food Summit, "*Food Security exists when all the people, at all times, have the physical and economic access to sufficient, safe, nutritious food for a healthy and active life*". The paper focuses on rural areas of several developing countries because these areas are traditionally more disadvantaged by national educational policies. The 2005 State of Food Insecurity report (FAO 2006, pp. 28-29) gave a relevant contribution to highlight the strong relationship between food insecurity on one hand and illiteracy and lack of education on the other. According to data available for rural areas of 22 developing countries, it shows how a higher level of undernourishment, used as a proxy of food insecurity, correlates with a lower level of literacy. This empirical research is intended to take this analysis one step further; while a high correlation does not explain the cause-effect relationship between the two variables, here the aim is to specify the capacity of education of rural people to explain food insecurity in rural areas.

The key element of this research pertains to the construction of a *cross-section* econometric model based exclusively on rural data. The goal is not to find a model to be used as starting point to construct a theory, but, to the opposite, to find some empirical evidence that justifies the impact of education on food insecurity. Following the Human Development perspective, such impact goes far beyond the enhancement of productive skills to be used in the labour world. The contribution concerns three main spheres: social, institutional, and economic. Based on this theory, education for rural people is expected to have a good explanatory capacity of food security in rural areas.

The paper is structured in the following way: the second part provides information on original data, variables and on the choice of indicators; the third part shows the outcome of a preliminary analysis of association and correlation between education and food security in rural areas; the fourth section shows the results of the econometric model, and, finally, in part 5 we draw our conclusions.

2. Dataset and Aggregate Indicators

2.1 Data

The data source is the *Demographic and Health Surveys* (DHS), an agency in charge of making surveys in sample areas of many developing countries.[1] The core instruments to carry out these surveys are household schedules and questionnaires for women aged 15-49. In the questionnaires women are asked to provide information on several topics concerning their household such as nutrition, fertility, prevalence of HIV-AIDS and other diseases, access to media, educational achievements. For the purpose of our analysis, those concerning education and nutrition will be primarily considered. Finally, data used in this specific research are those taken from the household surveys in rural areas and then aggregated at national level in order to have one data for each country.

The analysis is carried out on DHS data from rural areas of 48 developing countries. Countries are divided according to the following geographical distribution: 30 African, 10 Asian, and 8 Latin American countries. With regards to the time-frame, DHS data are not available for the same year in all the countries; these surveys were realized in different periods, varying from late 1980s to 2004. We decided to consider only data for a ten years period, i.e. between 1995 and 2004, because it is assumed that in such a period the structural nature of the relationship between the two variables does not have a significant modification. This is a reasonable assumption because in most of developing countries new educational policies were adopted around the middle 1990s. During this period the criticisms addressed to the structural adjustment policies led the World Bank and the International Monetary Fund to launch a new strategy based on the Poverty Reduction Strategy Papers (PRSPs). Thanks to the studies of eminent scholars and to the pressures of the civil society organizations, these economic institutions had to reconsider at least in part their development policies and strategies. This led to a universal

[1] The DHS surveys are partly financed by USAID and also the World Bank *Health, Nutrition and Population (HNP) Poverty Data* are based on DHS surveys. The aggregate data used for this research are available online at the web site http://www.measuredhs.com/aboutdhs/
Accessed on 27/09/2006

acknowledgment of the need of a greater balance among growth and equity, and social and economic investments such as education and health.[2] This policy shift marks a significant distinction between the impacts of education on food security in the last ten years from that occurred in the previous ten years. Thus, it is reasonable to take into account data for the period following this reform (1995-2004). In those countries where data for more years are available for the fixed interval of years, we decided to use the average value.[3]
Data are processed by Stata.

2.2 Variables

The variables originally considered are several: below we enclose only the list of those concerning rural areas and divide them according to the macro-distinction between educational and food security data.

Education for rural people.
Unfortunately there is a lack of data concerning education for rural people and in rural areas of developing countries.[4] Because of such data scarcity, education in this research is measured by school attendance and not by school completion. School attendance of people different age-groups can be reasonably considered as a good proxy for educational achievement in a country, but it does not encompass all the relevant information. There could be potential situations in which students go to school, attend lessons, but they do not succeed in final tests, so that they do not pass to next class. For instance, a 22-years old boy could be classified as a student even if he is just in a basic education programme. The variable literacy, which identifies the basic capacities to read and write, would provide complementary information since it pertains to an attainment that could be achieved even through informal education, which still has an important role in developing countries. However, data on literacy are available only for a very small group of countries. In order to overcome the weakness of this measure, school attendance for different age-groups of students will be complemented with another indicator of education, which distributes the total (rural) population along individuals' highest levels

[2] See among the others: Stiglitz (2001); Cornia et al. (1987); Psacharopoulos and Woodhall (1985).
[3] For more information on data treatment see Appendix A.
[4] The two expressions will be used in this paper as synonymous.

of school attended. Putting together these two categories of indicators allows having a more complete idea of the relationship between education and phenomena like food security. Here below we report the list of education variables.

1) Rural school attendance

rurattendance610	rural children 6-10 attendance rate (%)
rurattendance1115	rural children 11-15 attendance rate (%)
rurattendance1620	rural children 16-20 attendance rate (%)
rurattendance2124	rural children 21-24 attendance rate (%)

2) Educational level of rural population

rurnoedu	% of rural people with no education attended
rurminsecondary	% of rural people with secondary or higher educational level attended
rurtertiary	% of rural people with tertiary education attended

The variables included in these two groups are used as proxies of access to different levels of education:

1) **Primary Education**: measured by the school attendance rate for the rural population in the age-group 6-10, and by the percentage of rural people with no education attended (lack of primary education in the last case). It approximately corresponds to Level 1 of the International Standard Classification of Education 1997 (ISCED 1997).[5]
2) **Lower Secondary Education**: measured by the attendance rate for the rural population aged 11-15 school attendance. It corresponds to Level 2 of ISCED 1997.
3) **Basic Education:** measured by the attendance rate for the rural population aged 6-15 school attendance. Basic education is given by primary and lower secondary education. It corresponds to Level 1\2 of ISCED 1997.

[5] The DHS education data do not reflect precisely the ISCED 1997 international standards. The age-groups for school attendance are, instead, the same used by UNICEF. See, for example, UNICEF TransMONEE 2006 Glossary: http://www.unicef-icdc.org/resources/transmonee/2006/glossary_2006.pdf

4) **Secondary Education:** measured by the attendance rate for the rural population aged 16-20. It corresponds to Level 3 and 4 of ISCED 1997 (Secondary plus Post-Secondary Education).
5) **Secondary + Tertiary Education**: measured by the proportion of rural people that have attended at least secondary education. It corresponds to Level 3, 4, and 5 of ISCED 1997.
6) **Tertiary Education**: measured by the attendance rate for the rural population aged 21-24 and by the percentage of students who have attended tertiary education. It corresponds to Level 5 of ISCED 1997.

In order to have a general idea of the relevance of these levels of education in the countries considered we enclose below a table with the descriptive statistics.

Variable	Mean	Minimum	Maximum
PRIMARY EDUCATION:			
rurattendance610	60.43	13.40	91.70
rurnoedu	38.40	4.07	87.17
LOWER SEC. EDUCATION:			
rurattendance1115	67.16	14.30	98.00
BASIC EDUCATION:			
rurattendance615	63.41	13.70	93.20
SECONDARY EDUCATION:			
rurattendance1620	28.75	1.40	73.90
SECOND.+TERT.EDUCATION:			
rurminsecondary	19.19	1.30	76.69
TERTIARY EDUCATION:			
rurattendance2124	7.26	0.20	30.60
rurtertiary	1.61	0.00	8.84

The most relevant information derived by this table is that there are very few people that even start tertiary education in the rural regions of these developing countries. If, for instance, we use *rurattendance2124* as a proxy of tertiary education, only 7.3% of the people with an age between 21 and 24, on average, attend school, with a minimum of 0.2% in Niger and a maximum of 30.6% in South Africa. The relevance of tertiary education is even lower if it is measured by *rurtertiary*: 0.001% (minimum) in Mozambique and 8.84% (maximum) in Jordan. Data on both variables show very low

access to tertiary education, however small differences exist due to the differences in the variables used as proxies of "access to tertiary education": *rurattendance2124* reflects the percentage of rural people aged 21-24 attending school, while *rurtertiary* expresses the percentage of total current population that, even in the past, have attended tertiary schools. An African country, for example, might have relatively many people at tertiary school age who effectively attend school, but a lower proportion of adults that in the past attended at least one year of tertiary school.

Household Food Security

rurinfantmortality	rural infant mortality rate (%)
rurchildmortality	rural child mortality rate (%)
rurund5mortality	rural under-5 mortality rate (%)
rursevstg	rural severe stunting rate (%) [6]
rurmodstg	rural moderate stunting rate (%) [7]
rursevwstg	rural severe wasting rate (%) [8]
rurmodwstg	rural moderate wasting rate (%) [9]
rursevundwght	rural severe underweight rate (%) [10]
rurmodundwght	rural moderate underweight rate (%) [11]
rurlowbmi	percentage of rural women whose BMI is lower than 18.5 cm

2.3 Indicators

This section aims to explain which variables can be more relevant for the econometric estimation, and how variables can be aggregated in order to create an indicator. Such an indicator, which should incorporate the different elements of household food security, should

[6] Percentage of children under 5 that have an index of nutritional status: height-for-age below minus three standard deviations (SD) from the median of the reference population.

[7] Percentage of children under 5 that have an index of nutritional status: height-for-age below minus two SD.

[8] Percentage of children under 5 that have an index of nutritional status: weight-for-height below minus three SD.

[9] Percentage of children under 5 that have an index of nutritional status: weight-for-height below minus two SD.

[10] Percentage of children under 5 that have an index of nutritional status: weight-for-age below minus three SD.

[11] Percentage of children under 5 that have an index of nutritional status: weight-for-age below minus two SD.

be justified on a theoretical base. The model that, finally, will be constructed has some variables related to education as independent variables and one measure of household food insecurity as the dependent variable.
Regarding the characteristics of educational variables, both those concerning school attendance and those related to maximum level of education attended are relevant and will be object of analysis separately.

The analysis of the indicator for food insecurity requires more attention. In order to find an appropriate measure of such a phenomenon, we have to examine the existing literature on this topic and combine it with the available data and the purpose of our analysis. In this paper we intend to overcome the methods traditionally utilized to measure food security, i.e. those based on national food balance sheets. Therefore, in a very broad way, household food security indicators can be divided into three main categories:

1. *Food consumption indicators*: number of meals per day, number of calories, household percentage of expenditures on food, dietary diversity, which can be estimated through different ways, according to the specific context and available data.
2. *Anthropometric indicators*: relation height-for-age (stunting), relation weight-for-height (wasting), relation weight-for-age (underweight), female malnutrition (low Body Mass Index), micronutrients deficiency, iron deficiency, iodine deficiency.
3. *Livelihood indicators*: assets owned, feeling of insecurity, price of food, employment, health factors.

The choice of the indicator depends on the purpose of the exercise. Whether such a purpose is to monitor food security in its complexity in order to predict potential food crises due to one of these factors in one specific nation or region, it is essential to take into account all the typologies of indicators mentioned above. To the opposite, if the objective is to discover the general explanatory capacity of a variable (factor), such as education of rural people, on a phenomenon like the household food security in rural areas, a different analysis can be carried out. The cross-country model is based on some variables concerning education as predictors, while the dependent variable is an aggregate indicator of household food security. This means building up a structural model, which does not look at variations across time,

but is seen in a certain time, i.e. an interval of years between 1995 and 2004. This implies the possibility to search for a less detailed indicator, which can even be based on only one category, but which constitute a good proxy for household food security in that area.
In the specific case of this research available data for food security, taken from DHS household surveys, are mainly concerning nutritional status of children and women. We need to answer the following question: is it possible to use only anthropometric indicators as proxy of household food security in a structural model for several countries? Addressing the subject from a slightly different perspective, is it reasonable to assume that in all the countries where the surveys were carried out the correlation between food security and anthropometric indicators is very high and approximately at the same level?
Before answering the question we explain the weaknesses and strengths of the different categories of indicators and their role in defining food security. Measuring the relation weight-to-age, height-to-age and weight-to-height of children can, for instance, show the state of undernourishment, a relevant factor to monitor the life condition of a geographical area. There are also differences in these three measures: on the one hand height-to-age is a proxy of chronic malnutrition, on the other hand weight-to-age is a good proxy of transitory malnutrition. However, this type of indicators does not explain the cause of the problem. An example can clarify the concept: if a child is stunted, it could depend on many causes such as low food consumption, low dietary diversification, which are variables concerning food consumption. In this case, there is no need to include food consumption data because the outcome indicators (anthropometry) are very good proxies for them. However, if bad health conditions like HIV-Aids, cancer, anaemia or past experience of food insecurity are the only causes of stunting, then an analysis based exclusively on anthropometric indicators would reveal a high presence of food insecurity in a situation in which food insecurity does not occur. “Household food security is necessary but not sufficient for adequate nutrition” (Maxwell and Frankenberger 1992, p. 24). As a conclusion, the assumption that health conditions contribute approximately in the same way and to the same extent to food insecurity in the different areas is fairly reasonable.[12]

[12] For a better understanding of the linkages between nutrition and food security, see among the others: Beaudry (1996).

Finally, due to a good level of reliability of the assumption and the lack of availability of data on food consumption or expenditures, only anthropometric data and data on survival are utilized. Indeed, the main reason why the final indicators used in this study do not take into account data on food consumption or intake is that they are strictly connected to the personal income, while other variables like the prevalence of stunting or underweight incorporate more causes of undernourishment than the simple lack of adequate income. This type of variables reflect human deprivations, and "since our ultimate concern is with the nature of the lives that people can lead, there is a case for going straight to the prevalence of undernourishment, rather than to the intake of calories and other nutrients" (Anand and Sen 2003, p. 209). Amartya Sen (2003, p. 7) defines cereals, rice, and other food as commodities, while the capacity of people to convert them into something valuable like "being adequately nourished" depends on the personal characteristics (age, gender, and metabolism). Therefore we search for an "outcome indicator" (Maxwell and Frankenberger 1992, p. 96).[13] This valuable outcome is, finally, reflected in the most comprehensive definition of food security given during the World Food Summit in 1996: "*Food Security exists when all the people, at all times, have the physical and economic access to sufficient, safe, nutritious food for a healthy and active life*" (World Food Summit 1996). This definition of food security incorporates four main dimensions:

1. *Availability* of food, which is a necessary but not sufficient condition for food security.
2. *Physical access* to food, which stresses the role of distances, infrastructures, transportations.
3. *Economic access*, which depends on the economic condition of the household or individual.
4. *Utilization*, which focuses on different dietary needs of people, methods to cook food, and cultural acceptability of certain types of food.

Provided a theoretical justification of the variables chosen, it is necessary to find an indicator that encompasses a balanced mix of anthropometric, nutritional, and survival variables. This type of data reflects directly the personal capacity of individuals to convert

[13] For a deeper explanation and justification of an "outcome indicator" of household food security, see among others Hoddinott (1999).

commodities into a "good" nutrition. The indicator that we finally propose is an "outcome indicator" that includes three components:

- One component that defines "adequate survival status" (Wiesmann 2002), as a proxy of premature death due to malnutrition. While Wiesmann uses only the variable under-5 mortality rate, here an average value between this variable and the infant mortality rate is used because the causes of very early death can show a different intensity and typology of malnutrition (Wiesmann 2002).
- One component that reflects Wiesmann's idea of both: "adequate nutritional status" and "food adequacy". Here, they are expressed by the prevalence of stunting, underweight and wasting. The exact value of this component is expressed by an arithmetic mean of the values of the three indicators, and each indicator is expressed by the percentage of people that present that phenomenon in a moderate way (2/3 weight), and the percentage of people that present that phenomenon in a severe way (1/3 weight). To clarify this last sentence, the "prevalence of underweight" measured is constructed as a weighted mean of the variable *rurmodundwght* and the variable *rursevundwght,* in which the first one has 2/3 as a weight and the second 1/3.
- One component concerns "female malnutrition". Many experts did not use this indicator, but it is extremely important to check both the nutritional situation of one of the most disadvantaged categories (women) and, especially, to forecast possible food insecurity problems for the future. Most of the women will be mothers and their nutritional status will affect decisively the health of their children. This allows us to include also an element of "stability" over time of food security, which is one of its four main factors. In order to express female malnutrition data on the percentage of rural women whose body mass index is less than an internationally fixed threshold (18.5 cm) are used.

Calculating a simple arithmetical mean of the three components, which we define F_a, $F_{b,}$ and F_c, we obtain the proposed indicator of household food insecurity. The name of the variable, for rural areas, is *rurHFI1* and it is obtained through the following formula:

$$\mathbf{rurHFI1 = 1/3\ F_a + 1/3\ F_b + 1/3\ F_c}$$

which is a specific case with $\alpha=1$ of the general formula:

$$\mathbf{rurHFI = (1/3\ F_a^{\alpha} + 1/3\ F_b^{\alpha} + 1/3\ F_c^{\alpha})^{1/\alpha}.}$$

Keeping the weight of each sub-indicator equal to one third, which means assuming that each of them has the same relative value *ceteris paribus*, this formula varies according to the alpha. As indicated before, with alpha equal to one, the index is a simple arithmetic mean of the three components: this implies that, for example, a high value of F_a can be counterbalanced by a low value of F_c. However, since each component reflects a deprivation, we can reasonably claim that the *relative impact* of each one on the total analyzed phenomenon is likely to increase as the absolute level of that deprivation rises. An example might clarify the meaning of "relative impact":
Considering only one sub-indicator like F_a and three different levels of it: F_{a1}, $F_{a2,}$ and F_{a3}, with $F_{a3} = kF_{a2} = 2kF_{a1}$, a higher relative impact means that the same absolute variation of the sub-indicator F_a has a higher impact on household food insecurity if the starting level is higher, as formalized here below:

$$\frac{HFI(Fa2) - HFI(Fa1)}{Fa2 - Fa1} < \frac{HFI(Fa3) - HFI(Fa1)}{Fa3 - Fa1}$$

The empirical analysis can encompass such an argumentation by choosing a value of alpha higher than 1 in the general indicator of food insecurity presented above. In this research, a preliminary study is carried out with alpha equals to 2 in order to see what occurs when greater relevance is given to extreme deprivation.[14] With alpha greater than 1 there is not perfect substitutability between the sub-indicators: a high value of one sub-indicator cannot be totally counterbalanced by a low one of another.
Here below is the formula.
For alpha = 2:

$$\mathbf{rurHFI2 = (1/3\ F_a^{2} + 1/3\ F_b^{2} + 1/3\ F_c^{2})^{1/2}.}$$

Thus, *rurHFI1* and *rurHFI2* will be the two indicators of food insecurity utilized in the quantitative analysis.

[14] For both theoretical and mathematical explanation see Anand and Sen (2003, pp. 211-218).

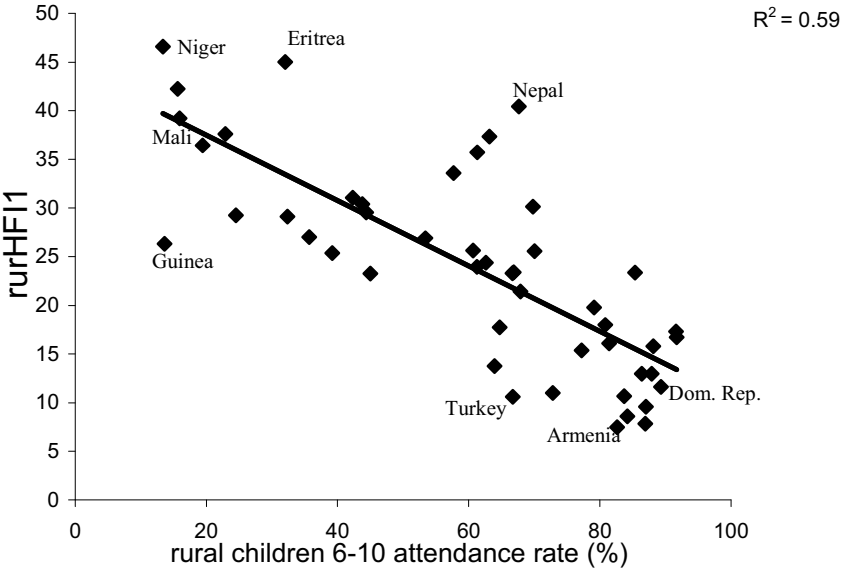
3. Exploratory Analysis

This section investigates the relationship, both linear and non-linear, between the multiple variables concerning education for rural people and the two indicators of household food insecurity in rural areas. In the first part of the exploratory analysis we intend to represent graphically the bi-directional relationship between educational variables and food insecurity. The second technique adopted is the correlation coefficients, through which we verify the form of relationship between the specified variables. It is opportune to remind that this analysis concerns exclusively the rural areas of the developing countries included in the surveys.

3.1 Graphical Tools

The scatter plots are good tools to start the analysis of the relations between education and food insecurity among rural people. As a first step, we examine the distribution of the countries in a scatter plot with the different school attendance rates in the x-axis and the indicator *rurHFI1* of food insecurity in the y-axis. The black line represents the regression line when education is the independent variable and food insecurity the dependent one.

Graph 1. 6-10 school attendance rate – rurHFI1

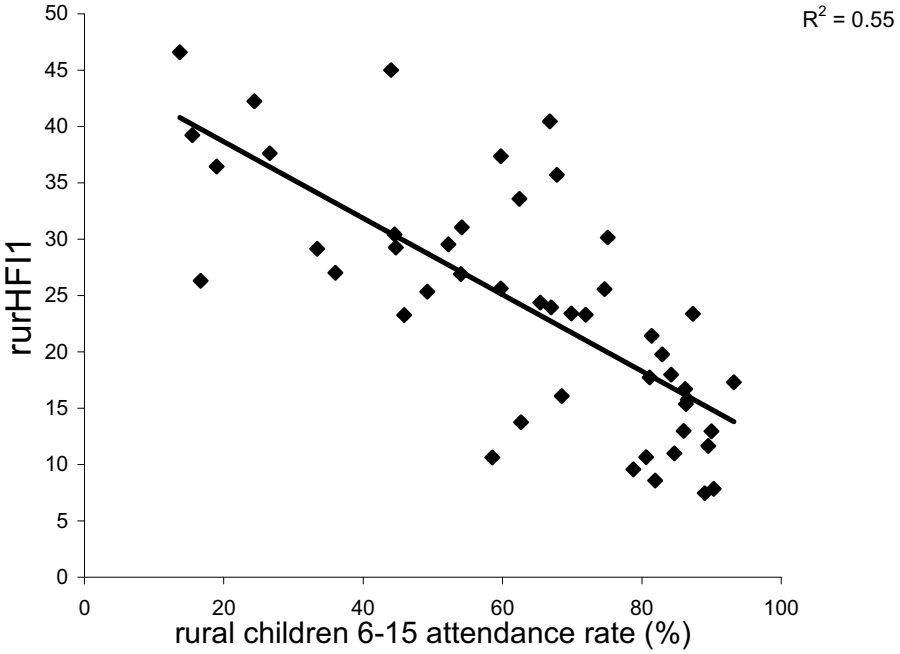


Graph 1 reveals a clear pattern: the higher the access to primary education, the lower rural food insecurity. On the top-left corner, a country like Mali has low levels of access to primary education and high levels of food insecurity. On the other hand, a country like the Dominican Republic, situated in the bottom-right side of the graph, has a very good performance in primary education associated to a low intensity of food insecurity. Furthermore, if attention is shifted from a bi-directional study (association education - food insecurity) to a casual relationship (how education explains food insecurity), it is possible to note that the countries have a combination of the two variables close to the pattern marked by the black line, as testified by the high value of the R-Square (0.593).

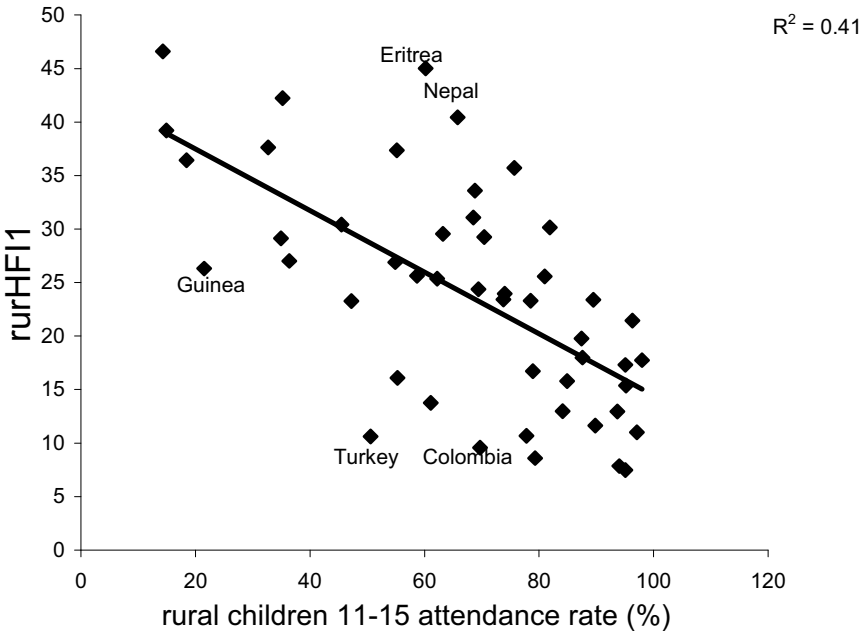
This simple graph already suggests that a linear and negative correlation exists between access to primary education and household food insecurity. There are, indeed, some countries ("outliers") which are further from the line and whose names are displayed. For instance, Turkey has a middle-high percentage of younger students who attend school in rural areas, while the level of food insecurity is very low. In Guinea, the school attendance rate is very low, but the level of food insecurity is not so dramatic in relative terms. Nepal, instead, is a country with a good rate of school attendance among rural people, but it is the fourth country with the highest proportion of food insecure people. Niger has the non-enviable record of both lowest attendance rates of students in the specified age interval, and the largest percentage of rural population in condition of food insecurity.

Then, we analyze the changes derived by the inclusion in the previous graph of a different target for the school attendance. Graphs 2 and 3 respectively focus on students in the age group between 6 and 15 (proxy of basic education) and in the age group between 11 and 15 (proxy of lower secondary education).

Graph 2. 6-15 school attendance rate – rurHFI1



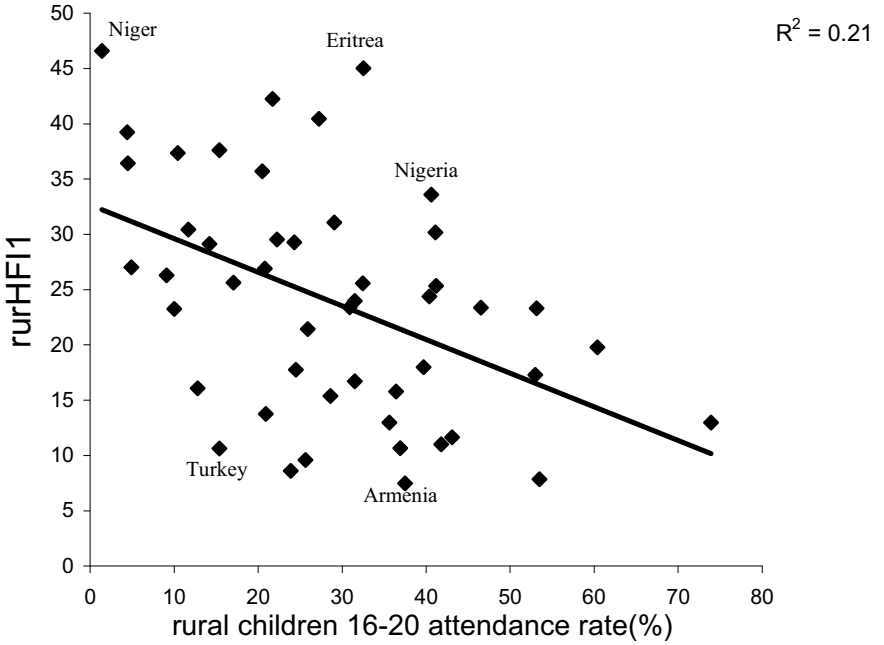
Graph 3. 11-15 school attendance rate – rurHFI1



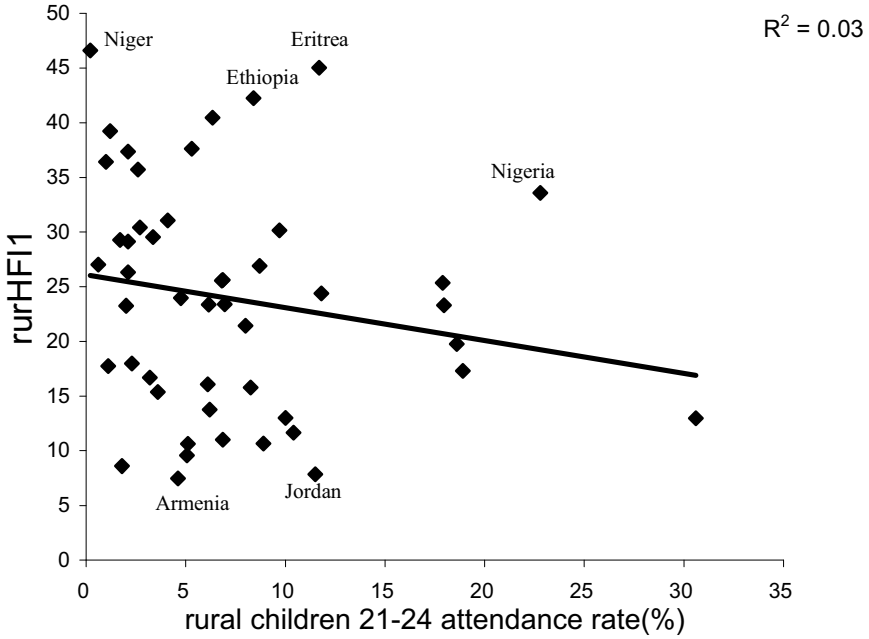
The comparison between graph 1 and graph 2 shows that the difference between the two situations is very low. In the second graph there are just few observations slightly further from the line: this means that the correlation between education and food insecurity, investigated in detail in next sections, is lower when the attendance rate concerns students with an age between 6 and 15 instead than between 6 and 10. This depends on the fact that as students' age increases, their presence at school is less connected to the prevalence of food insecurity in the rural areas of the country.
In graph 3 both the number of outliers and their distance from the line are much larger than in graph 2. Colombia represents the most evident situation due to a proportion of students with an age between 11 and 15 who attend school very close to the total mean and its very low proportion of people suffering from food insecurity.

The last two variables related to school attendance are those referred to people's age groups 16-20 and 21-24: they are respectively proxy of secondary and tertiary education. Graph 4 and 5 show the association of these variables with the first indicator of food insecurity.

Graph 4. 16-20 school attendance rate – rurHFI1



Graph 5. 21-24 school attendance rate – rurHFI1

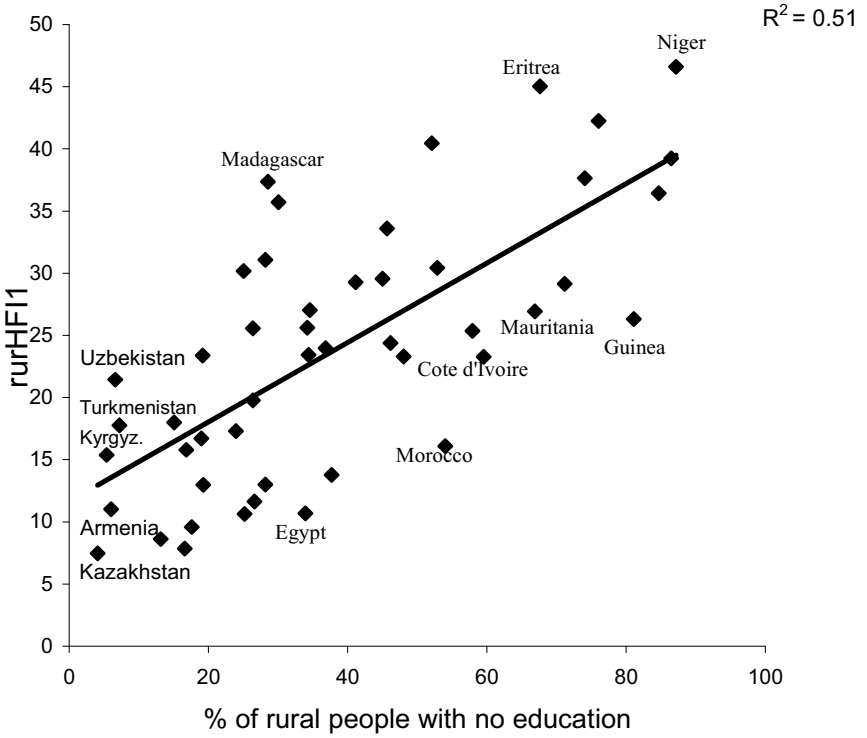


Graph 4 highlights a negative correlation between 16-20 school attendance rate and household food insecurity, but clearly lower than in previous charts. Finally, in graph 5 the observations do not have a monotonic trend so that *we cannot conclude that for wider tertiary schooling there is a lower level of food insecurity*. The observations do not follow a linear pattern, which means that there is no collinearity between the variables. The R-Square, in fact, is extremely low in both the cases: 0.20 and 0.03.

This first investigation suggests that, in general terms, education so as reflected by school attendance rate, is negatively related to household food insecurity.

The scatter plots below show the relationship between the maximum level of education attended and food insecurity.

Graph 6. No education – rurHFI1



Graph 6 shows the positive relationship between the percentage of people that did not even attend primary education and food insecurity. This means that people who do not go to primary school are highly exposed to hunger. In the scatter plot, countries are located close to the fitting line, which signs the presence of linear correlation. On the other side, there are two groups of countries: first, those outliers with a *relatively* lower prevalence of food insecurity compared to the high or very high proportion of people without any formal education. These countries are Morocco, Guinea, Cote d'Ivoire, Mauritania and Niger. Second, countries like Armenia, Kazakhstan, the Kyrgyz Republic, Turkmenistan, and Uzbekistan, are not in the same area of the graph so as marked by the fitting line, but seem quite homogenous.
There are two points to outline with regard to the distribution of countries in graph 6:

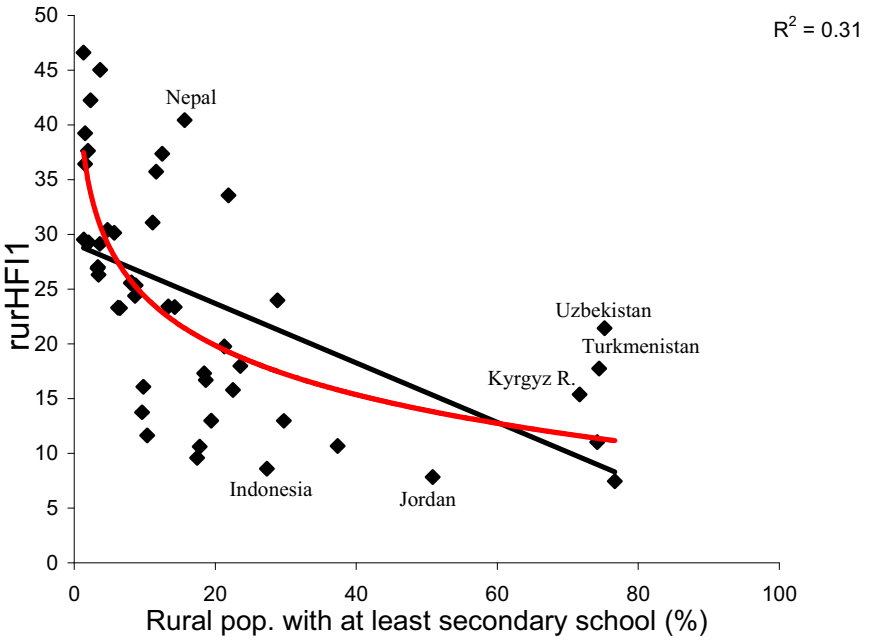
1. Unlikely previous studies, these two groups of countries have a specific geographical collocation: only African countries fall into the first category of outliers, and only countries from Central-

Western Asia fall into the second cluster. Focusing just on the diverse levels of education, the differences are due mainly to the well-known massive investments in education made by former Soviet Union states.

2. The identified Central-Western Asian countries are not evident outliers, and some are even placed above the line while others below. However, they all have high educational achievements associated to low level of household food insecurity. It is reasonable to argue that up to a certain point further presence of educated people is not connected anymore so strictly to food security, then it does not make much sense to outline that one country has a *relatively* higher food insecurity compared to the extremely low percentage of uneducated people. To sum up, in situation in which a variable takes an extreme value, the regression line as a reference point looses its meaning. We can draw a similar conclusion regarding the African countries located in the bottom-right side of graph 6: for high percentage of uneducated people, each additional numbers of people with this characteristic is not so negatively connected to highest levels of food insecurity. Given this assumption, for these two groups of states it is relevant to analyze just the absolute levels of the two phenomena, without taking into high consideration the line.

In the next graph we examine the relationship between the percentage of people having attended at least secondary education and food insecurity.

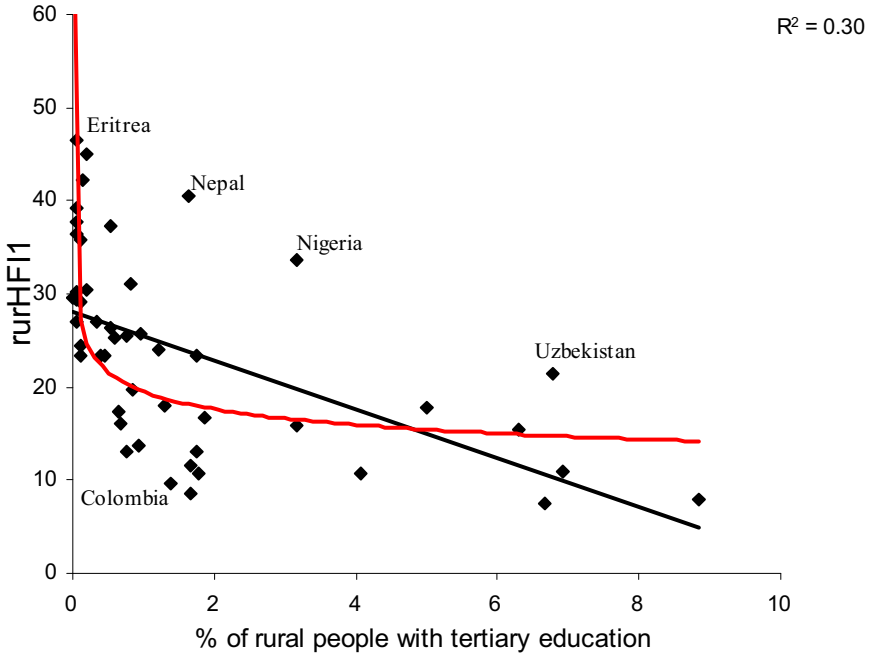
Graph 7. At least secondary education – rurHFI1



The scatter plot shows that some countries, again the same Asian ones mentioned in the previous graph, have a different set of the two variables. They are situated on the right area, above the regression line. Although these countries present conditions dissimilar to the others, a negative relation between access to secondary or higher education (measured by the percentage of rural people with at least secondary education attended) and food insecurity is in place. A straight line, anyway, cannot properly express such a relation; the relation, in fact, is even clearly far from being monotonic. The observations are not randomly disposed; excluding the outliers, there is a trend that can be better represented by a logarithmic curve. Concluding from the examination of graph 7, it might be argued that secondary or higher education is weakly correlated to food insecurity, and the highest rates of access to secondary education are not associated to the lowest rates of food insecurity.

Finally, the graph below displays the nature of the relationship between tertiary education and food insecurity.

Graph 8. Tertiary education – rurHFI1



The situation above is apparently very similar to that in the previous graph. A deeper examination suggests that, although in the area below the line the situation is the same, above the line there are more "outliers", which lead the pattern of residuals far from being linear. The validity of this statement will be challenged only with the correlation analysis of next chapter, which will assess the validity of a "no correlation" hypothesis. Furthermore, also in graph 8 the logarithmic curve (red curve) explains better the relationship between the two variables. This means that the marginal impact of access to tertiary education in the rural areas of a developing country on food insecurity is high only when a country moves from a situation with no access to tertiary education to a very low access to tertiary education. Graph 8 seems to suggest that, on average, if a country manages to increase the percentage of rural children with tertiary education from 2% to 3% or 4%, this does not have any effect on food insecurity in rural areas. Finally, even between tertiary education and food insecurity there is a negative relationship, albeit not very marked and not linear.

This first analysis, based on graphical tools (scatter plots), shows that the distribution of the observations in a chart with education in the x-axis and food insecurity in the y-axis follows clear and linear patterns with primary, basic, and even lower secondary education. This means that those countries with larger access to primary or basic education are more likely to register low food insecurity. The pattern, instead, is less and less defined for higher levels of education: there is no empirical evidence that countries with higher access to secondary or tertiary schooling are more likely to have lower levels of food insecurity.

Finally, since the scatter plots showing the two-way relationship between the different levels of education and the second indicator of household food insecurity (*rurHFI2*) produce results very similar to those reported, they are not enclosed.

In section 3.2, where we address the issue of correlation, we report also the changes occurring when higher weight is attributed to larger deprivations, i.e. using the variable *rurHFI2* instead of *rurHFI1*.

3.2 Correlation Analysis

In previous paragraphs preliminary conclusions were drawn on the relationship between education and food insecurity in rural areas on the basis of graphical tools. Here, the problem of the *nature* and the *form* of the relationship between these two factors will be addressed more in detail by using the Spearman's and the Pearson's correlation coefficients. Both vary between -1 (perfect negative correlation) and +1 (perfect positive correlation), but they have an intrinsic difference, which can affect the results.

Pearson's coefficient is a linear correlation coefficient, which is seriously affected by the presence of outliers and non-linearity in the relation. Spearman's rho, instead, is defined as a "quasi ordinal" correlation coefficient because it is calculated by applying the Pearson correlation formula to the ranks of the data rather than to the actual value of data. The relevant distinction lies in the lower influence exercised by outliers in the Spearman's rho. It is useful to utilize them together in order to investigate the linearity of the relationship. If Pearson's rho is much smaller than Spearman's rho applied to the same variables, then it is reasonable to conclude that the variables are substantially correlated, but not linearly. When both correlation

coefficients show very similar values, close to one, there is linearity. This methodology is applied to our variables.

Table 1 displays both the correlation coefficients between all the variables concerning school attendance and the measure of food insecurity *rurHFI1*.

Tab 1. Pearson and Spearman coefficients: *School Attendance - HFI1*

Coefficient	**6-10**	**6-15**	**11-15**	**16-20**	**21-24**
Pearson	-0.770	-0.744	-0.644	-0.457	-0.182***
Spearman	-0.788	-0.760	-0.643	-0.453	-0.235***

The similarity of the values in the two coefficients is visible for all types of indicators for education. This means that the consideration of a more general type of correlation, as measured by the Spearman's index, does not add relevant information to a linear correlation.
Food insecurity is more (negatively) correlated to the school attendance of younger children, thus to primary, and then basic education. In the last case, correlation between *rurHFI1* and *rurattendance2124*, both coefficients are not significant, i.e. the null hypothesis of "no linear correlation" cannot be rejected.

Table 2 shows the correlation between food insecurity and the second category of educational variables.

Tab 2. Pearson and Spearman coefficients: *Educational Level - HFI1*

Coefficient	**noedu**	**minsecondary**	**tertiary**
Pearson	0.718	-0.558	-0.547
Spearman	0.713	-0.714	-0.710

The coefficients in table 2 are slightly different from those in table 1. While Spearman's and Pearson's rho have very close values in the first column (both positive since not having attended any level of

*** Not significant at 0.1 significance level.

school is directly associated to being food insecure), in the other two cases this statement does not work anymore. In analyzing the form of the relationship between the percentage of food insecure people and the percentage of people with at least secondary education attended, it is evident that linearity is anyway valid but the identification of other forms of relation could largely improve the analysis. Accordingly, the values of Spearman's coefficients are -0.714 and -0.710, versus Pearson's coefficients equal to -0.558 and -0.547. Moreover, by how the Spearman's coefficient is composed, it does not appropriately show the distance of outliers from the fitted line, because it is anyway classified according to its own ranking position, while Pearson's coefficient takes it more into consideration. In our case, as showed by graphs 7 and 8 of this section, there are many more outliers; this contributes to sign a remarkable difference between the two coefficients. As explained in section 3.1, the non-linear correlation is not of easy comprehension.
Concluding from tables 1 and 2, the pattern of the relationship between food insecurity and education is similar whatever category of education variable: school attendance rate or educational level. The higher is the age of children attending school or the higher is the level of education, the lower is the linear correlation with food insecurity. The extreme situation is represented by the variable *rurattendance2124*, proxy of tertiary education, which can be said not to be linearly correlated to any of the indicators of food insecurity.

The previous arguments are approximately valid whatever indicator is used for food insecurity. However, there are small changes in the absolute value of Pearson's coefficient if we use the second indicator of food insecurity. Here below tables 3 and 4 show the correlation coefficients with *rurHFI2*.

Tab 3. Pearson and Spearman coefficients: *School Attendance - HFI2*

Coefficient	**6-10**	**6-15**	**11-15**	**16-20**	**21-24**
Pearson	0.693	-0.569	-0.554	-0.471	-0.195***
Spearman	0.697	-0.699	-0.686	-0.450	-0.209***

*** Not significant at 0.1 significance level.

Tab 4. Pearson and Spearman coefficients: *Educational Level - HFI2*

Coefficient	**noedu**	**minsecondary**	**tertiary**
Pearson	0.693	-0.569	-0.554
Spearman	0.697	-0.699	-0.686

Adopting indices with higher alpha (higher weight given to condition of extreme deprivation) has a kind of smoothing effect on the value of Pearson's coefficient in the variables of each group concerning education. The correlation is always high between food insecurity and school attendance for younger students but lower with *rurHFI2*, while it is slightly larger for 16-20 age students. Even the correlation between *rurHFII* and *rurnoedu* decreases as the alpha increases, while it has the opposite effect on higher levels of education.
Finally, the correlation analysis contributes to re-enforce some arguments that are at the basis of the whole research and that were preliminary confirmed by the graphical analysis.

- Countries where there are good levels of primary schooling are more likely to be food secure.
- Countries where there are good levels of secondary schooling are not necessarily more likely to be food secure.
- The fact that a country has good levels of tertiary schooling does not affect the probability to be food secure.

4. An Econometric Model

In this section we do not focus anymore on a simple two-way relationship between different grades of education and food insecurity in rural areas, but we try to investigate causalities. We aim to assess the quantitative impact of education for rural people on food insecurity in rural areas. At the same time, we intend to examine what is the level of education that affects the most food security. For this purpose, we construct a specific model for rural areas. We propose two types of analysis, and in both the cases we show the results of the estimation for the indicator *rurHFI1* and *rurHFI2*.

1. An analysis that includes all and exclusively variables related to education as explanatory variables and the indicator of household

food insecurity as dependent one. This study leads to conclusions, which are statistically weaker than the second case, but can show even the internal differences between the single educational variables in their contribution to food insecurity.

2. A second analysis, which includes more independent variables, some of which not concerning education. The purpose is, again, to study the impact of education on food insecurity but controlling for some, mainly non-economic, variables. This approach is stronger from the point of view of statistical methodology and, obviously, shows a reduced capacity of education to predict food insecurity.

4.1 Models with only educational variables

The results of the first OLS estimation, obtained through the step-wise procedure, are given in the table below.

Model 1.1: Impact of education on food insecurity in rural areas

Dependent variable: **rurHFI1**	Coefficient	Standard Error
constant	**43.376**	**2.565**
rurminsecondary	**- 0.117**	**0.049**
rurattendance610	**- 0.284**	**0.044**
R-square	**0.638**	

Through the post-estimation tests we verified that this model has the following statistical properties:

1. Significance of each coefficient (0.05 level) and of the whole model
2. Normality in the distribution of the error terms
3. Lack of multi-collinearity
4. Homoskedasticity
5. Linearity of the relationship
6. Correct specification

The limit of this analysis lies in the relatively small absolute value of the R Square (0.638), which indicates the fit of the model and, especially, in the high value of the constant (43.376). This is due to the fact that only explanatory variables related to education were introduced in the model. It is clear that there are other variables, reflecting access to water, sanitation, access to information, ownership of assets, and other economic and financial factors that can sensibly modify the access to food of a household. However, this model allows a comparison between the variables proxy of primary, basic, lower secondary, and higher levels of education. The equation below formalizes the results of this model:

HFI1 = 43.376 – 0.284primary – 0.117minsecondary

The educational variables that, jointly, affect the most food insecurity are access to primary education and access to at least secondary education. The absolute value of the contribution of primary education on food insecurity is more than double than that provided by access to at least secondary education; the coefficient associated to the attendance rate of children between 6 and 10 is 0.284 versus 0.117, which the coefficient is associated to the percentage of people with at least secondary school attended. Both the coefficients are negative.

The model 1.2 outlines the results of the second estimation, with *rurHFI2* as indicator of food insecurity.

Model 1.2: Impact of education on food insecurity in rural areas

Dependent variable: **rurHFI2**	Coefficient	Standard Error
constant	**53.650**	**3.267**
rurminsecondary	**- 0.161**	**0.063**
rurattendance610	**- 0.336**	**0.056**
R-square	**0.619**	

This model, as well as the previous one, has all the main statistical properties. The difference is that this estimation suffers from larger limits concerning the fit of the model (R-square = 0.619) and the value of the constant (53.65).
Not keeping into consideration the constant, which actually does have importance, the impact of both the educational variables is higher than in the previous case, but the intra-variables differences are lower. Finally, comparing the two models, education has larger incidence on food insecurity when the alpha of the indicator of HFI is higher, which means that more extreme situations in one of the three components of the indicator have a relatively higher weight.

4.2 Models with control variables

This second model takes into consideration many more independent variables than just those reflecting education. It was decided to construct a model that explains the impact of education on food insecurity controlling for non-economic variables. The additional variables are all connected to sanitation, health, access to drinkable water, access to media, because they were reasonably assumed to have an important relevance on the level of food insecurity at the household level. There are no variables related to income due to the lack of data, but there is one variable related to the ownership of different types of assets. The lack of any of these non-productive assets is here used as a proxy of (assets-based) poverty. Finally, we decided not to include most of the factors related to physical environment and institutional environment. These are the supplementary variables for the step-wise regression:

rurradio	% of rural households with access to radio
rurnoasset	% of rural households with no basic assets[15]
rurwater	% of rural households with drinkable water
rurhealth	% of rural children under 5 with diarrhoea disease[16]
rurnohygiene	% of rural households without toilet facility
Dcontinent	Dummy continent [17]
Dconflict	Dummy for presence of conflict in the country [18]

[15] This is a measure of assets-based poverty.

The table below reports the results of the estimation realized through a step-wise regression and after an accurate analysis of sensitivity.

Model 2.1: Determinants of food insecurity in rural areas

Dependent variable: **rurHFI1**	Coefficient	Standard Error
constant	**27.482**	**3.723**
rurnoasset	**0.127**	**0.045**
rurattendance610	**- 0.204**	**0.039**
rurnohygiene	**0.110**	**0.028**
R-square	**0.768**	

This model presents all the same statistical properties of models 1.1 and 1.2.
In addition to the previous model, it has a much higher value of the R-Square (0.7768 vs. 0.6382) and an extremely lower value of the constant (19.82 versus 43.37). This means that the results of this model are much more reliable. In absolute terms the value of R-Square is satisfactory, and the inclusion of one variable directly reflecting income-based rather than assets-based measure of household poverty would make it closer to 1. Furthermore, reasonably this variable would not catch large information now captured by education, leading to the acceptance the outcome of this analysis.

Moving from a statistical analysis to the theoretical explanation of the model, there are a few conclusions that can be derived. First, the results can be expressed through the following equation:

[16] Calculated for the two weeks preceding the survey.
[17] This dummy variable takes value 1 if the country is African, and value 0 if is from another continent.
[18] This dummy variable takes value 0 if there was no conflict in the country at the moment of the survey, and values 1 in case of conflict. The data source is not DHS, but the Centre for the Study of Civil War (CSCW), web site: http://www.prio.no/cscw , accessed on 8/09/2006.

HFI1 = 27.482 – 0.204primary + 0.127noasset + 0.110nohygiene

Therefore, the main determinants of food insecurity in rural areas are:

1. *School attendance* of children with an age between 6 and 10, which is the best predictor.
2. *Assets-based poverty*. The coefficient associated to this variable (0.127) shows that the ownership of non-productive assets is relevant to fight food insecurity, but its impact results lower than the impact of primary education.
3. *Lack of basic hygienic conditions*, which still gives a satisfactory (positive) contribution to food insecurity. The higher this percentage, the more problems concerning sanitation, and therefore, the more food insecure people, all the rest being the same.

Given the objective of this analysis, more attention is attributed to the educational variable. The percentage of youngest children attending school is, here, considered as a proxy of primary or basic education, and it must be outlined that it is the only variable related to education left in the model. This means that if the aim is to reduce food insecurity in rural areas, which reflects an elementary achievement of a person or a family in life, effort should be made to enhance more primary rather than basic, secondary, or tertiary education. The results are coherent with the theoretical framework: the coefficient associated to this variable is statistically highly significant (p-value = 0.000) and equal to - 0.204, outlining a good capacity to explain food insecurity. The fact that, for instance, the variable *rurradio* was removed is likely to be due to the strongest information contained in *rurattendance610*, which should embody also the information given by *rurradio*. In fact, the eventual added value of being able to access radio is provided by the capacity to receive properly the messages concerning sanitation, health, and food utilization, which depends mainly on the education obtained. The most interesting outcome is that access to primary education seems to provide a wider contribution to food security than a measure of poverty based on ownership of assets (0.20 vs. 0.12).

In this estimation the economic variable (*rurnoasset*) is included as control variable, thus it is interpreted as exogenous to the process through which education affects food insecurity in rural areas. This is

not a very realistic assumption since it is well-known that more education influences the income/productivity of a nation, even probably more than the inverse causality. Therefore, the results produced in the previous paragraph might underestimate the total impact of people's education.

A possible criticism to this result could be the lack of a time lag between school attendance of children and its effects on food security, meaning that the impact of an educated society on food security is not immediate. However, this could be overcome by considering school attendance of younger children as a proxy of total literacy, since an analysis of correlation carried out on 132 developing countries and countries in transition, using data from the UNESCO Institute for Statistics, showed a correlation coefficient between adult and youth literacy very close to 1 (0.964)[19] and a very large correlation between parents' education and children's education. Furthermore, it should be considered that the percentage of educated people for each level (primary, basic, secondary and tertiary) changes very slowly in a short-medium period.

Here below we report the results of the step-wise regression with *rurHFI2* as food security indicator.

Model 2.2: Determinants of food insecurity in rural areas

Dependent variable: **rurHFI2**	Coefficient	Standard Error
constant	**34.459**	**5.006**
rurnoasset	**0.162**	**0.613**
rurattendance610	**- 0.246**	**0.053**
rurnohygiene	**0.127**	**0.038**
R-square	**0.748**	

[19] Source: Global Education Database: http://qesdb.usaid.gov/ged/index.html, accessed on 21/07/06

The resulting equation is:

HFI2 = 34.459 – 0.246primary + 0.162noasset + 0.127nohygiene

The structure of the model is very similar to the structure of the previous model. Concluding from this estimation, which has a slightly lower explanatory capacity than the previous one (R-square = 0.748 vs. 0.768 and higher value of the constant), for higher weights to extreme food deprivations (indicator *rurHFI2*), the negative contribution of one additional unit of primary education to food insecurity is 0.246. Even here, the results of the model are underestimated due to the limiting assumption of exogeneity of the economic component.

Finally, we can conclude that primary education heavily affects the level of food insecurity in rural areas of developing countries; a doubling of access to primary education can reduce food insecurity by 20% or 24% depending on the definition given to the latter and how we measure it. Where the objective of policy-makers is to reduce dramatic levels of hunger, it is generally better to invest in primary education for rural people than in higher levels of education.

5. Concluding remarks

Education is widely recognized as one of the key dimensions of development. Two Millennium Development Goals: 2 and 3, directly focus on education. In the same way, the Education for All initiative, and especially the first World Conference held in Jomtien in 1990 and the successive conference held in Dakar in 2000 concentrate on education, and more specifically, on *primary education*. Also the World Food Summit in 1996 acknowledged the critical role of education in achieving food security. This research attributes a further value to education: education for rural people is a key factor in fighting food insecurity in developing countries. Recognizing the inter-linkages between rural people deprivations such as lack of education on the one hand, and food insecurity and malnutrition on the other hand, is fundamental in order to have a more comprehensive view of the MDGs. This way, it is possible to have a framework in which both ends and instruments for development are well identified.

Furthermore, this research focuses on *rural areas* of developing countries. Despite their statistical predominance in the developing world where they still represent more than 70 percent of the overall population, rural people are usually discriminated by national policies in many sectors, including education. Although many studies were carried out with regard to the "urban bias" (e.g. Lipton 1977; 1981), only few documents of international organizations include rural as vulnerable people and areas. Many national and international studies, and many statistics are not disaggregated by rural-urban areas, and this does not give a full image of the situation in developing countries. This research suggests that, in rural areas of developing countries, there is a high correlation between food insecurity and lack of education, especially for low levels of education.

The most relevant result of this research is probably that *primary* more than basic, secondary or tertiary education for rural people contributes to the promotion of food security in rural areas. While the graphical examination and the analysis of correlation show that both primary and basic education have a significant negative bi-directional relationship with food insecurity, the econometric model provides further information. The model, which investigates causality, shows that primary education, even more than basic education has a larger (negative) impact on food insecurity. The analysis suggests that, if a developing country such as Mali, which is among those with lowest levels of education, manages to double access to primary education, it can reduce the intensity of food insecurity by approximately 20% or 24% in rural areas, depending on the measurement of food insecurity. The results of this analysis depend on the situation still characterizing rural areas of developing countries in the last years. Although since the Jomtien EFA Conference and the WFS much progress has been done in order to meet the global goals concerning access to primary education and food security, still much need to be done. Finally, this empirical study suggests that, as a general priority, governments should invest on primary education, which, not by chance, was identified as the MDG n.2, which follows in priority immediately after the MDG referring to poverty and hunger to which it is closely correlated. However, intra-countries differences exist; thus, a context-based analysis of educational field would be necessary to address the problems of a specific developing countries.

Finally, the conclusions derived above are not confined to rural areas. On average, more than 57% of the population within the developing countries included in this study live in rural areas (see Appendix B). If these statistics are considered together with those showing that world poverty is essentially a rural phenomenon (70%), we can extend the results of this study: *education for rural poverty is a key factor for enhancing overall national food security*, thus for achieving MDG 1: "Eradicate extreme poverty and hunger". This is even more valid for the (thirty) African countries taken into consideration, since 63.16% of people in these countries live in rural areas.

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APPENDIX A. Data treatment

Originally, the research focused on 49 developing countries with the following geographical distribution: 30 from Africa, 11 from Asia, and 8 from Latin America. However, there were missing values in some variables for a few countries. Thus, before proceeding with the correlation analysis, data needed to be cleaned. The first element to outline in this appendix is that all data were transformed in percentage values in order to make them uniform and facilitate the interpretation of the constant in the regression model.

The second and more important point concerns the treatment of missing values. Originally, data for 49 observations were collected, but due to missing values, some observations are likely to be lost. In order to avoid it, it was chosen to use the "donor method" for the missing treatment, which is based on the cluster analysis. This method consists firstly in identifying the variables that are more correlated to that one with a missing value. In the second step these variables, which usually vary between one and four, are used to run a cluster analysis. Through this technique, we can find out which are the observations closer to the observation with the missing value. Once a very homogeneous cluster is found, the missing value is substituted by the mean of the cluster. In this case, the other countries that are in the cluster are the "donors". Finally, to check the relative correctness of the procedure attention was drawn to the distribution of the "donor countries" around the original variable (that one in which one value is missing): the lower is the standard deviation the better the analysis is. This procedure was applied on four countries: Namibia, South Africa, Indonesia, and India. In the first three cases, the missing values were concerning some variables related to food security, and the obtained results were quite satisfying. On the opposite, India, which had missing values for higher school attendance rates, presents a set of values for both educational and food security variables very different from the general pattern tracked by the other countries. For this reason, it was difficult to find a cluster in which India was included: even with a very limited number of clusters build up on the basis of other school attendance rates, India was always in a 1-country group. The lack of adequate information to fill the missing values and the relevance of these two variables for the analysis led us to remove the

observation India. In conclusion, the quantitative analysis is carried out on 48 countries.

APPENDIX B. Statistics on rural population

Country	Continent	Rural population (%)	Source	Year
Benin	Africa	55.5	IFAD[20]	2003
Burkina Faso	Africa	81.4	UNFPA[21]	most recent
Central Africa	Africa	56.2	UNFPA	most recent
Cameroon	Africa	47.8	IFAD	2004
Chad	Africa	74.2	UNFPA	most recent
Comoros	Africa	64.4	IFAD	2004
Cote D'Ivoire	Africa	54.2	UNFPA	most recent
Egypt	Africa	57.2	IFAD	2003
Eritrea	Africa	80	IFAD	2003
Ethiopia	Africa	83.4	IFAD	2003
Gabon	Africa	14.8	UNFPA	most recent
Ghana	Africa	67.4	IFAD	2003
Guinea	Africa	63.5	UNFPA	most recent
Kenya	Africa	63.7	IFAD	2003
Madagascar	Africa	69.2	IFAD	2003
Malawi	Africa	83.3	IFAD	2004
Mali	Africa	67.7	IFAD	2003
Mauritania	Africa	35.7	UNFPA	most recent
Morocco	Africa	41.9	UNFPA	most recent
Mozambique	Africa	64.4	IFAD	2003
Namibia	Africa	66.5	UNFPA	most recent
Niger	Africa	76.7	UNFPA	most recent
Nigeria	Africa	53.4	IFAD	2003
Rwanda	Africa	93.4	IFAD	2003
South Africa	Africa	42.1	UNFPA	most recent
Tanzania	Africa	64.6	IFAD	2003
Togo	Africa	63.7	UNFPA	most recent
Uganda	Africa	84.7	IFAD	2003
Zambia	Africa	59.7	IFAD	2003

[20] IFAD statistics available at: http://www.ruralpovertyportal.org/english/regions/index.htm
[21] UNFPA statistics available at: http://www.unfpa.org/profile/

Zimbabwe	Africa	64.1	UNFPA	most recent
Armenia	Asia	35.7	IFAD	2004
Cambodia	Asia	80.3	UNFPA	most recent
Indonesia	Asia	55.9	IFAD	2003
Jordan	Asia	20.9	UNFPA	most recent
Kazakhstan	Asia	44.1	UNFPA	most recent
Kyrgyz R.	Asia	66.3	UNFPA	most recent
Nepal	Asia	87.1	IFAD	2003
Turkey	Asia	32.7	UNFPA	most recent
Turkmenistan	Asia	54.2	UNFPA	most recent
Uzbekistan	Asia	63.6	UNFPA	most recent
Bolivia	L. America	35.6	UNFPA	most recent
Brazil	L. America	17.2	IFAD	2003
Colombia	L. America	22.6	UNFPA	most recent
Dominican R.	L. America	39.9	UNFPA	most recent
Guatemala	L. America	59.4	IFAD	2003
Haiti	L. America	61.2	UNFPA	most recent
Nicaragua	L. America	42.7	IFAD	2003
Peru	L. America	26.1	IFAD	2003

All surveys	**57.075**
Africa	**63.16**
Asia	**54.08**
L. America	**38.0875**