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# Reducing Children's Food Insecurity through Primary Education for Rural Mothers: The case of Mozambique

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**FAO Disclaimer**

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## 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 |
| **HAZ** | Height-for-Age Z-Score |
| **HNP** | Health, Nutrition and Population |
| **ICN** | International Conference on Nutrition |
| **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 |
| **UN** | United Nations |
| **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 |
| **WHO** | World Health Organization |
| **WHZ** | Weight-for-Height Z-Score |
| **2SLS** | Two-Stage Least Squares |

# OVERVIEW

Food insecurity and poverty in low-income countries are at the heart of the current work of the international community. The 1st Millennium Development Goal gives priority to halve by 2015 the proportion of people suffering from poverty and hunger. The Food and Agriculture Organization (FAO) has the mandate to monitor progress towards achievement of this goal. The 2005 State of Food Insecurity (SOFI) report, published by FAO, shows how poverty and hunger are essentially rural phenomena, closely related to the lack of education. Given the strong correlation between poverty, hunger and education, in 2002 the FAO launched the Education for Rural People (ERP) partnership programme in collaboration with UNESCO. Up to the present, about 300 partners - international organizations, national governments, academic institutions, civil society, and the media - have joined the programme. This research contributes to the policy work of the ERP partnership.

## Study rationale

In an era of scarce resources, this research helps provide criteria to policymakers for setting priorities among different sectors of investments, and for priorities for different levels within the education system.

In recent years, the policy and research development agenda has highlighted the inter-relatedness among illiteracy, poverty, food insecurity, and gender inequalities. It is now well understood that poverty is a multi-dimensional phenomenon, not a simple lack of income. Poverty means lack of health, lack of housing, lack of self-esteem, lack of food, lack of hope, lack of empowerment and participation, and lack of education. With the Millennium Development Goals, the U.N. launched a new strategy based on recognition of the multiple dimensions of poverty and the need to overcome them by interdisciplinary, inter-sectoral work, and interagency collaboration. The core idea behind the Millennium Strategy is the inter-linkages among multiple factors of development, including the relation between lack of education and lack of access to food. The Millennium Strategy and Project provided the policy and operational framework for a change from traditional agricultural production and supply- driven approaches to people-centred sustainable development policies. The multidisciplinary approach to the MDGs permitted a broadening of the focus of poverty and food insecurity reduction efforts to include education and training of all of those who live in the traditionally neglected rural space.

These policy changes culminated in the Millennium Summit and were nurtured by several key development events of the 1990s. At the first International Conference on Nutrition (ICN) held in December 1992, 159 States declared: “we recognize that poverty and the lack of education, which are often the effects of underdevelopment, are the primary causes of hunger and undernutrition” (Article 5 of the World Declaration on Nutrition). In 1996, the World Food Summit (WFS) Plan of Action adopted several commitments which identified education as a key to poverty eradication, durable peace and food security (commitment 1, objective 1.4). Commitment Two (objective 2.1) refers to the need to develop human skills and capacities through basic education and pre- and on the-job training. Objective 2.4 of

Commitment Two stresses the need for "promoting access for all, especially the poor and members of vulnerable and disadvantaged groups to basic education" in order to "strengthen their capacity for self-reliance". The Summit calls governments, in partnership with all actors of civil society to "promote access and support for complete primary education" with particular attention to "children in rural areas and to girls". In 1990, Article 3 of the Education for All (EFA) Declaration stressed that an active commitment must be made to removing educational disparities by focusing on underserved groups specifically including the poor, working children and rural and remote populations. Article 5 of the same Declaration focused on the need to broaden the means and scope of basic education by also focusing on basic skills training for youth and adults including agriculture techniques.

The analytic focus of this research is on the connections between education and food insecurity in rural areas. Seventy percent of the world's poor—defined as those with income of less that 1 dollar per day—lives in rural areas (see, for example, World Bank 2003). However, many of the development strategies developed by national governments and donors overlook the rural reality and focus mainly on urban and peri-urban areas.

It was in this context that the ERP strategy was developed. This research has been undertaken by the University Roma Tre, Department of Economics, in collaboration with FAO, under the auspices of the ERP partnership. Department of Economics, is an institutional member of ERP since it is deeply committed to work in this area, offering a Master's degree programme in Human Development and Food Security and a PhD in Institutions, Environment, and Policies for Economic Development. This collaboration between the University Roma Tre and FAO, Department of Natural Resources, aims to strengthen awareness of the importance of investments in basic education for rural people in low-income countries, to help improve overall standards of living and to help meet especially MDGs 1, 2, 3 and 7 as well as all other.

# 1. Introduction

Food insecurity and lack of education are two of the most dramatic deprivations developing countries are currently experiencing. World statistics show that both the phenomena are essentially rural. The first research jointly conducted by the University Roma Tre and FAO: "Education for Rural People: A Neglected Key to Food Security" (Burchi and De Muro 2007) shows that investing in *primary education for rural people* is fundamental in order to fight household food insecurity in low-income countries. Concentrating larger efforts in primary education could allow to significantly progress, simultaneously, towards the achievement of three Millennium Development Goals: MDG1, MDG 2, and MDG 3.

The second part of this research project is closely related to the first one. Education for Rural People affects positively food security through different channels: some economic and some socio-institutional channels. One of the key relationships that links education to food security at national level in a dynamic setting is that between mother's education and children's nutrition. Drawing attention to the nutrition of children below five can at the same time provide information about past and current food insecurity/malnutrition in a country and provide information about future long-term food insecurity. Children, in fact, are the future generations. Moreover, children in the age-group between 0 and 5 are those that do not attend school yet, thus ensuring their food security can be a key for their education in the close future. Too many times educational experts and statistics analyze education as only concerning those that are in school-age. In a longer perspective it is necessary to focus on those that should join the educational system or that are condemned to be left out by poverty and hunger. Therefore, this is a further reason for undertaking this research.

Many studies in different low-income countries showed that mother's schooling has a significant positive impact on child nutrition (e.g. Thomas et al 1990; Glewwe 1999). Some of these also compared situations in rural and urban areas. The aim of this paper is to take the research one step forward. First we examine the level of mother's schooling that affects the most child food security. This is particularly important to understand policy tools that governments and international organizations should adopt to fight hunger. Then, we decompose the total impact of mother's schooling into two macro-channels: one economic channel (increase of income and productivity), and one social channel, which refers to the basic capacity to process information concerning issues such as health, hygiene, and nutrition coming from media. Televisions, newspapers, and especially radios are widespread even in remote rural areas of African areas. The idea is to investigate if what counts is the subjects mothers directly learn in school (direct impact of mother's schooling), if their schooling is mainly translated into skills and professional abilities to use in the labour market (indirect economic impact), or finally if attending school provides mothers with the basic tools to acquire knowledge in other ways and other environments (indirect social impact). Since the *direct* contribution that mother's schooling provides to child food security is likely to be only a minimum part of the overall contribution, it is useful to study if life-skills (e.g. processing information concerning nutrition, health, and hygiene) or productive skills (professional abilities) are the most relevant channels through which mother's schooling *indirectly* contributes to ensure children food security.

This research will focus on rural households living in Mozambique. The reason of this choice lies in the slow or, sometimes, "negligible" progresses recorded in the last years by African countries in both education and food security. Furthermore, Mozambique is a country with a prevalent rural dimension, which makes it particularly suitable for this study.

The analysis will be carried out using data from the Demographic and Health Surveys (DHS) 2003 on 4,776 rural children with an age below 60 months. The paper is structured in the following way. In chapter two, we review the existing literature on the topic, pointing out the findings relevant for our research. In chapter three, we explain the theoretical model that should clarify the relationship between mother's schooling and child food security within rural households. In chapter four, we provide information about data, variables, and indicators. In the fifth part, we show the descriptive statistics regarding the most important variables: mother's educational attainment and literacy, child food security, access to media, and household wealth. In this section, we also use graphical tools and correlation analysis to explain the nature and the form of the relationship between these variable. Then, we explain methodology and results of the econometric study. Estimations are made through Ordinary Least Squares (OLS) with gradual inclusion of additional variables. Last section concludes with policy recommendations for Mozambique and possible application of these results to other African countries.

## 2. The State of the Art of the Literature

While there is almost no work on the linkages between education and food security at national and household level, there is a considerable literature that studies the relationship between mother's and father's education and child food security. In this section, we briefly review a part of this literature, with a special emphasis on the researches carried out in rural areas of developing countries. It is important to outline that this paper does not just intend to add another piece of writing to this vast literature, but it tries to answer further questions, usually neglected by these authors. Section three will show in depth the innovative elements of this research.

Many scholars usually assume that between mother's education and child health/nutrition there is a positive relationship because an educated mother can allocate inputs more efficiently and can acquire more knowledge regarding child health/nutrition, through which she can increase the efficiency of the chosen inputs. It seems that the core part of the empirical literature confirms this positive influence (e.g. Thomas et al. 1991; Glewwe 1999; Garrett and Ruel 1999; Girma and Genebo 2002; Morales at al. 2005).[1]

One of the most important outcomes of these researches is that mother's education is important for child health and nutrition besides the income that the mother and the household own. For example, in North-East Brazil, Thomas et al. (1991), using data from the 1986 Demographic and Health Survey (DHS), found that mother's years of schooling gives a significant contribution to child health so as measured by the

[1] These results were obtained through different estimation methodologies, ranging from OLS to 2SLS models, from logistic regressions to quantile regressions.

relation height-to-age of children below five.[2] Once the authors control for household (instrumented) income, maternal education is still highly significant and the coefficient associated to it declines by only 8.5 percent in rural areas and by 12 percent in urban areas. In Mozambique, Garrett and Ruel (1999, p. 31), using data from the 1996-1997 national household demographic and expenditure survey, concluded that mother's education has a positive impact on child food security of children in the age-group 0-5 – whether measured by calorie availability or height-for-age – "above and beyond the income effect".

For the purpose of this research it is important to outline two sub-groups of studies in this field: first, those distinguishing between short-term and long-term child food security/nutrition, and then those distinguishing between urban and rural areas.

Some authors have compared the results obtained with child height-for-age (HAZ), commonly accepted as a good proxy of long-term nutritional status, with those obtained with weight-for-height (WHZ), a better proxy for short-term nutritional status. Many researchers (e.g. Webb and Block 2003) suggested that factors such as mother's education and economic goods affect more HAZ than WHZ. Haddad et al. (2002) analyze sixteen household datasets in twelve different developing countries, and conclude that parental education has a (positive) significant influence on WHZ in only one third of them. However, there is a minority of studies that reported a non-significant difference in the impact on HAZ or WHZ (Morales et al. 2005, in Bolivia), or even a lower impact on HAZ (Penders et al. 2002 in Mali). Penders et al. (2002), using DHS data for Mali, do not only find out that maternal education affects more WHZ than HAZ, but they obtain that maternal education does not have a significant contribution on child HAZ, and it has a significant contribution on child WHZ.

Different results are, then, obtained in analysis focusing on rural or urban households. Leaving aside discrepancies in the methodologies adopted to estimate these disparities, the largest part of the literature shows that mother's education has a more significant influence on child anthropometrics in rural areas (Thomas et al. 1991; Girma and Genebo 2003). In Ethiopia, for example, Girma and Genebo (2002) conclude that in rural areas "The likelihood of being stunted was found to be double among children of mothers with no education compared with children whose mothers have some secondary or higher education", while in urban areas it was 1.6 times higher (Girma and Genebo 2002, p. 18).[3]

Thus, there seems to be a fair empirical evidence of the relevance of rural mothers' education for rural children's nutrition. Next sections aim to assess the validity of this conclusion in the case of rural Mozambique.

[2] This measure of child anthropometrics is commonly used in the literature. Since we are going to use this variable for the empirical analysis, in the section dealing with the dataset WE will explain better the characteristics of this indicator.

[3] Stunting is a measure of the (under)nutrition of the child, but often also used as a proxy of her or his food (in)security.

## 3. Theoretical Model

This research aims to answer four fundamental questions: 1) Is mother's education a relevant predictor of child food security in rural areas of Mozambique? 2) What is its quantitative contribution? 3) Up to which level of mother's education it is currently necessary to invest in order to alleviate food insecurity in rural areas? 4) What are the main channels through which mother's education benefits child food security?

The main scope of the paper is much broader than just answering if mother's education has a positive influence. Regarding the first issue, we apply an econometric strategy with a gradual addition of new variables, in order to see how the coefficient associated to the variables reflecting mother's education varies.

Regarding the second question, in the last estimates we will highlight the approximate *direct* incidence of mother's education.

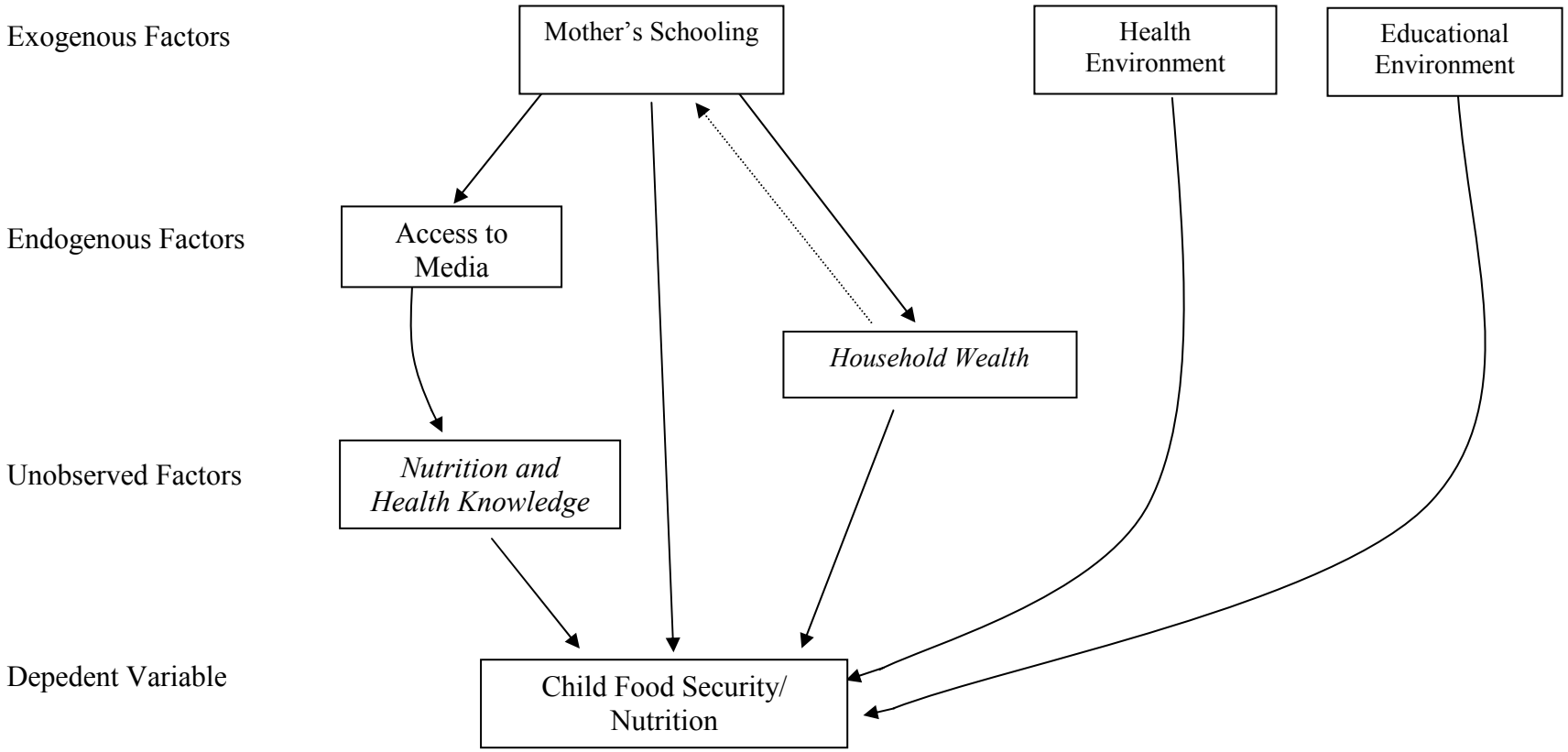
Then, we try to answer the third question by utilizing four different variables related to education, each one indicating if the mother has that level of education or not. The variables are the following: "some primary education"; "complete primary education";[4] "some secondary education"; "Complete secondary or higher".[5]

This is significantly different from traditional studies, which use the variable "years of schooling"; according to us, the latter does not properly reflect the additional contribution that each level of education might provide.[6]

With respect to the fourth issue, the diagram (figure 1) shows briefly some direct and indirect contributions of mother's education to child food security. First, following Amartya Sen (1997), being educated can promote development (and other socio-economic factors such as food security) through two key macro-channels: "social change" and "economic production". Regarding the first channel, for instance, an educated woman can acquire more and elaborate better information on health, nutrition and sanitation, all aspects that work in favour of their children's food security.[7] Since it is impossible to measure health and nutrition knowledge of a person, this paper will use mother's access to mass media as a proxy.[8] The other crucial pathway of influence is typical of the human capital literature: mother's education increases household income, which partly will be used for the well-being of the children. Finally, since the DHS dataset used for the study on rural Mozambique does not have information on literacy and numeracy, these impacts will

[4] Primary education in Mozambique lasts seven years, differently from most of other African countries where it lasts five years.
[5] Secondary education in Mozambique lasts five years. In order to complete secondary education, a child should have successfully overcome twelve years of schooling.
[6] In particular using years of schooling as the only variable reflecting education means assuming that there is a linear relationship between mother's education and child food security. This assumption seems deeply unrealistic.
[7] Having information about these key topics can improve the *utilization* dimension of food security (World Food Summit 1996). For instance an adequate and diversified diet and a right way of cooking food are essential elements in order to convert calories into children's good nutrition.
[8] As showed in figure 1, nutrition knowledge is unobserved; thus, theoretically, access to information through media might be endogenous. Endogeneity of this variable will be tested through the Wu-Hausman test.

**Figure 1. Relationships between mother's education and child food security**



flow directly in the impact that mother's education directly has together with the knowledge of subjects studied in school.

The fourth issue will be mainly addressed with the inclusion of the interaction terms between education variables and the two channels: household wealth and access to information. This allows to examine if the two phenomena work together in order to reduce food insecurity. Furthermore, especially in the case of the interaction between mother's education and wealth the direction of the relationship is much more likely to go from education to wealth rather than *vice versa*.[9]

# 4. Dataset

The dataset used here is the 2003 Demographic and Health Survey (DHS) in Mozambique. DHS is one of the few sources of data that provide information on education in rural areas of low-income countries. DHS collects information regarding several topics such as nutrition, fertility, prevalence of HIV-AIDS and other diseases, access to media, and educational participation, in sample areas. In Mozambique, the sample is composed of 375 rural and 229 urban areas. Full data are available for 7,121 children in the age-group between zero and five, who are still alive at the moment of the survey. The analysis will focus on the 4,776 children living in rural areas.[10]

The variables are grouped in child characteristics (food security, age and sex), mother's characteristics (age, age at first birth, sex, marital status, education, nutrition and access to information), father's characteristics (education), household characteristics (size, proportion of member below five of age and wealth) context variables (availability of electricity, health, sanitation and education environment).

Here below the full set of variables used for the quantitative analysis is described.

## 4.1 Child Characteristics

Child Food Security. Child height-for-age, the dependent variable, is firstly a proxy of child nutritional status; however it has been frequently used to indicate child health. In this paper, we argue that it is also a good proxy of long-run food security. The specific variable is the height-for-age z-score (HAZ) of children under five of age. The z-score is adjusted for child's sex and age, and measures how close the child is to the NCHS/WHO reference population.[11] A child is defined "stunted" when her or his height-for-age is more than two standard deviations below the NCHS/WHO

[9] Although wealth surely allows the household to pay school fees, mother's schooling in Mozambique seems exogenous. That is why the line with inverse direction is displayed in figure 1, but it is dashed.
[10] DHS follows the definition of "rurality" provided by each country. In general terms, rural areas are those with less than a fixed number of residents (e.g. 2,500 in some countries in Sub-Saharan Africa), far from cities, and with poor infrastructure.
[11] The nutritional parameters of North American children and women at the beginning of the 20th century were conceived as "ideal"; thus, such a population was defined by WHO as the reference one for both children's and women's anthropometry.

reference, and "severally stunted" when her or his height-for-age is more than three standard deviations below it.

Child's Age. It is a quantitative variable indicated in months.

Child's sex. It takes value zero if it is male and one if it is female. In the existing literature there is no empirical evidence whether nutritional indicators are better for male or female children.

### 4.2 Mother Characteristics

Mother's Age. Differently from other authors in the field, this paper uses a quantitative variable for mother's age (in years), rather than a set of binary variables for mother's age groups.

Mother's Age at first child's birth. Mother's age at first child's birth might reflect mother's health and other background characteristics of mother and household.

Mother's current Marital Status. One binary variable is added to show if child food security differs depending on the current marital status of the mother. It takes value 1 if the woman is currently married and value 0 if she was only married in the past.

Mother's Schooling. As outlined in the previous chapter, we measure mother's educational attainment with four binary variables, expressing whether the mother has that level of education or not. Although still related to only formal education, it reflects an outcome, and allows me to answer the second crucial question of this research: which level of mother's education provides larger benefits to child food security?

Mother's Nutrition. In DHS dataset, there are two main anthropometric measures for mothers. The first is the height-for-age z-score, which is calculated with the same rationale outlined for children. The second is the body mass index, a typical indicator of nutritional status for adult women. Body mass index is obtained dividing mother's weight in kilograms by the square of her height in meters. Even in this case, nutritionists fixed a cut-off point: 18.5 centimetres, below which a woman suffers from poor nutritional status.

Mother's Access to Media. It is measured by whether child's mother watches television, reads a newspaper, or listens to radio at least once a week. We have constructed one quantitative variable of access to information.[12] Following literature and governmental documents, we constructed the aggregate indicator *Accessmedia*, which is a proxy for total mother's access nutrition information. Further information on the construction of this indicator is reported in Annex 1.

### 4.3 Father Characteristics

Father's Education. The focus of this paper is on mother's education, it was decided to use the quantitative variable "father's years of schooling". Having just one

[12] This was also necessary in order to test the endogeneity of such a variable and apply 2SLS estimator.

quantitative variable simplifies the interpretation of the model, without heavily limiting the informational capacity of father's education.[13]

### 4.4 Household Characteristics

Household size and composition. Household size is the number of household members. Another variable is the proportion of household members with less than five years of age.

Household Wealth. In DHS surveys there are no questionnaires on household consumption or expenditures, but there is the indicator "wealth index", which according Rutstein and Johnson (2004, p. 4) in developing countries better reflects household permanent income than other measures. The DHS wealth index is constructed applying a principal component analysis on a set of variables: ownership of assets (e.g. car, bicycle, and refrigerator), ownership of land, the type of flooring, and use of public utilities (electricity, water, public well, public sewerages).

### 4.5 Context Characteristics

Availability of Electricity. The proportion of households in a geographical area[14] that has electricity at home is an important aspect of the physical environment in which a child lives.

Sanitation. Hygienic conditions are reflected in the variable: proportion of households with available toilet facilities in a cluster area.

Bad Health Environment. Mortality rate of children below 5 in the five years preceding the survey represents the health environment of a cluster area. Following the Capability Approach (e.g. Sen 1999), this is a relevant "functioning",[15] distinguished by health resources that are instruments to improve children health.

Educational environment. DHS dataset does not contain data on the quality aspect of education. However, following even in this case the Capability Approach, it is possible to argue that the educational environment can be better represented by functionings such as literacy in the geographical context, rather than from indicators related to number of schools or teachers. For this paper, we use mother's literacy rate at cluster level.

[13] For instance, here we are not interested in examining which educational level of the father is crucial for child's food security.
[14] The geographical area is the "cluster" area, which is the secondary sampling unit in DHS sampling scheme. In rural areas there are 298 clusters.
[15] Functionings are those things that people manage to be and to do in their life. Being healthy and being educated are two relevant functionings.

# 5. Exploratory Analysis

## 5.1 Descriptive Statistics

Table 1 shows the descriptive statistics of all the variables, except for the Provincial dummy variables.

Table 1. Descriptive statistics in rural areas

| | Mean | St. Dev. | Min. | Max. |
|---|---|---|---|---|
| Child HAZ (0-5) | -1.841 | 1.446 | -6 | 4.62 |
| Child ‘s Age in months | 27.8167 | 17.179 | 0 | 59 |
| Child is female? | 0.493 | 0.500 | 0 | 1 |
| Mother’s Age (15-24) | 0.312 | 0.463 | 0 | 1 |
| Mother’s Age (25-29) | 0.271 | 0.444 | 0 | 1 |
| Mother’s Age (30-34) | 0.197 | 0.398 | 0 | 1 |
| Mother’s Age (35-39) | 0.121 | 0.326 | 0 | 1 |
| Mother’s Age (40-49) | 0.097 | 0.296 | 0 | 1 |
| Mother’s Age at first birth | 18.452 | 3.575 | 10 | 39 |
| Mother is currently married | 0.922 | 0.268 | 0 | 1 |
| Mother has some primary education | 0.459 | 0.498 | 0 | 1 |
| Mother has completed primary education | 0.019 | 0.138 | 0 | 1 |
| Mother has some secondary education | 0.006 | 0.080 | 0 | 1 |
| Mother has at least completed secondary education | 0.000 | 0.014 | 0 | 1 |
| Proportion of HH Members <5 | 0.338 | 0.121 | 0.029 | 0.75 |
| Mother’s Nutrition | -1.456 | 1.015 | -5.32 | 4.23 |
| Mother’s Body Mass Index | 2157.359 | 252.843 | 1315 | 4611 |
| Mother’s Access to media | 2.498 | 1.832 | 0 | 7 |
| Father’s years of schooling | 3.005 | 2.665 | 0 | 17 |
| HH members | 6.850 | 3.564 | 2 | 34 |
| HH Wealth | -48623.94 | 30764.55 | -75576 | 387691 |
| Children 0-5 Mortality Rate in cluster area | 0.115 | 0.060 | 0 | 0.370 |
| Community Availability of Electricity | 0.261 | 0.037 | 0.160 | 0.364 |
| Sanitation | 0.554 | 0.028 | 0.490 | 0.754 |
| Educational Environment | 0.159 | 0.167 | 0 | 0.735 |

Sample size: 4,776.

First, on average, children are in conditions of moderate malnourishment (-2 SD) and some children arrive to be far below the line of severe malnourishment (-3 SD). On average mothers have their first child when they are around 18; this is likely to be the cause of other bad performances in well-being dimensions. For instance, only 45.9 percent of them attended at least some years of primary school and only 0.6 percent of all rural mothers have at least started secondary schools. At the same time,

mothers are not adequately nourished: on average, they are 1.45 SD below the reference WHO population.

Father's education, as well as mother's education, is a key problem since, on average, they attend just 3 years of formal education. Finally, it is hard to describe economic conditions of the families because the wealth index is not measured in a standard unit. The comparison between economic conditions of households in rural and urban areas might partly help to interpret these data.

The second step is the comparison in values of the most relevant variables between rural and urban areas of Mozambique. Column two of table 2 presents the value for urban areas, column three for urban areas, and column four presents their differences.

Table 2. Difference between Rural and Urban Areas

| | Mean Rural areas | Mean Urban areas | Difference |
|---|---|---|---|
| Child HAZ (0-5) | -1.841 | -1.350 | -0.491 |
| Mother has some primary education | 0.459 | 0.802 | -0.343 |
| Mother has completed primary education | 0.019 | 0.171 | -0.152 |
| Mother has some secondary education | 0.006 | 0.118 | -0.112 |
| Mother has at least completed secondary education | 0.000 | 0.011 | -0.011 |
| Mother HAZ | -1.456 | -1.217 | -0.239 |
| Mother's Body Mass Index | 2157.359 | 2302.157 | -144.798 |
| Mother's Access to media | 2.498 | 4.045 | -1.547 |
| Father's years of schooling | 3.005 | 6.024 | -3.019 |
| HH Wealth | -48623.94 | 60861.21 | -109485 |
| Children 0-5 Mortality Rate in cluster area | 0.115 | 0.105 | 0.010 |
| Community Availability of Electricity | 0.261 | 0.270 | -0.009 |
| Sanitation | 0.554 | 0.573 | -0.019 |
| Educational Environment | 0.159 | 0.534 | -0.375 |

Sample size: Rural Areas = 4,776; Urban Areas = 2,345.

The difference between rural and urban areas is always at the advantage of the latter. For all the variables, people in rural areas record better values. The well-being of households, children, women and men is, on average, much higher in Mozambican cities. This suggests a probable presence of the so-called "urban bias" (Lipton 1977; 1984). For example, while only around 45 percent of mothers have attended at least some year of primary education in rural areas, this percentage raises to around 80 percent in urban areas. The mean value of the wealth index is positive among urban households, while negative among rural households.

## 5.2 Exploratory Analysis

The exploratory analysis is a necessary step in order to understand the direct, bilateral linkages between some key variables. This study is carried out through two main tools: correlation analysis and scatterplots.

### 5.21 Correlation

Table 2 presents Pearson's correlation coefficients between the most crucial variables for this research.[16]

In both correlation and scatterplots mother's education is measured by its original variable "educational attainment", which has the following modalities:

0 = "no education"; 1 ="incomplete primary"; 2 = "complete primary"; 3 = "incomplete secondary"; 4 = "complete secondary"; and 5 = "higher".

As expected, mother's education has a statistically significant positive correlation with child food security in rural areas (coefficient = 0.097). That is, when a mother has achieved a higher degree of education, her children are more likely to be food secure, all the rest being the same. However, the intensity of this correlation is lower than, for instance, the correlation between mother's education and wealth (coefficient = 0.300) or access to media (coefficient = 0.180), which are the two identified channels (see figure 1). This is not surprising because mother's education, wealth and access to media interact to each other. Only the econometric model will allow to understand the type and the strengths of the mechanisms that are in place, and that finally might contribute to a reduction in children's food insecurity.

Regarding other variables, the most intense correlation occurs between mother's nutrition and child food security/nutrition. Also this result was widely predictable. Biological models suggest that parents' anthropometrics directly affect child nutritional status during early childhood. A malnourished mother is more likely to have a child suffering from nutritional problems (Barrera 1990).

[16] Pearson's coefficient ranges from -1 (perfect negative correlation) to +1 (perfect positive correlation). A coefficient close to zero suggests no correlation.

Table 3. Pearson's Correlation in rural areas

| | Child Food Security | Mother's Nutrition | Mother's Educational Attainment | Wealth index | Father's Schooling | Access to Media | Family Size |
|---|---|---|---|---|---|---|---|
| Child Food Security | 1.000 | | | | | | |
| Mother's Nutrition | 0.208*** | 1.000 | | | | | |
| Mother's Educational Attainment | 0.097*** | 0.105*** | 1.000 | | | | |
| Wealth index | 0.105*** | 0.127*** | 0.300*** | 1.000 | | | |
| Father's Schooling | 0.089*** | 0.077*** | 0.373*** | 0.274*** | 1.000 | | |
| Access to Media | 0.063*** | 0.061*** | 0.180*** | 0.287*** | 0.179*** | 1.000 | |
| Family Size | 0.007 | 0.096*** | 0.032** | 0.111*** | 0.036** | 0.082*** | 1.000 |

*** = significant at 0.01-level, ** = significant at 0.05-level, * = significant at 0.10-level.
Sample size: 4,776.

## 5.22 Scatterplots

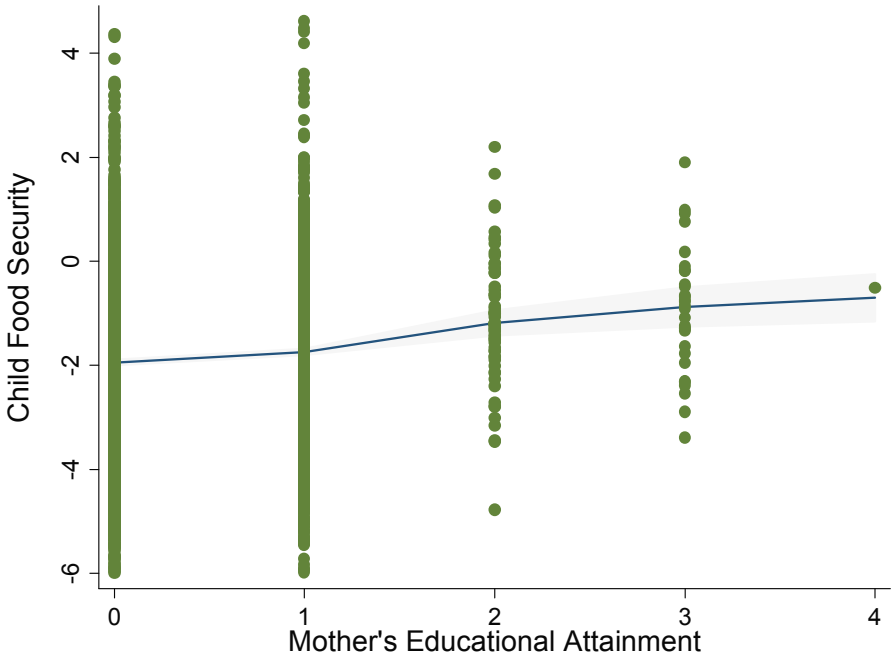
Correlation refers to the linear direct relationship between two variables. Scatterplots with interpolating line help to understand better the relationship setting on of the variables as dependent variable and the other as independent variable. In particular, these tools help to identify the form of the relationship.

Since, in both sections 3 and the first part of section 4, we have seen that factors such as education, wealth, and child's food security are likely to interact strictly among themselves. Here below, we try to investigate more their linkages.

First, figure 1 shows the relationship between mother's education (in x-axis) and child food security (in y-axis). It is interesting to note how children whose mother has started primary education have only small better performances in nutritional indicators than children of mothers that did not attend school at all. Instead, when mothers manage to complete primary education, their children seem to have, on average, much better nutritional outcomes than children with mothers with only some years of primary education. In fact, in correspondence of level 1 (incomplete primary education) there is an evident raise in the slope of the curve. By level 2 (complete primary), instead, the slope decreases, suggesting that wherever mothers go beyond primary schooling, their children are not much more likely to be food secure than when they just stop at the completion of primary education. This is one of the key questions that, in section 5, will be deeply analyzed within an econometric model.

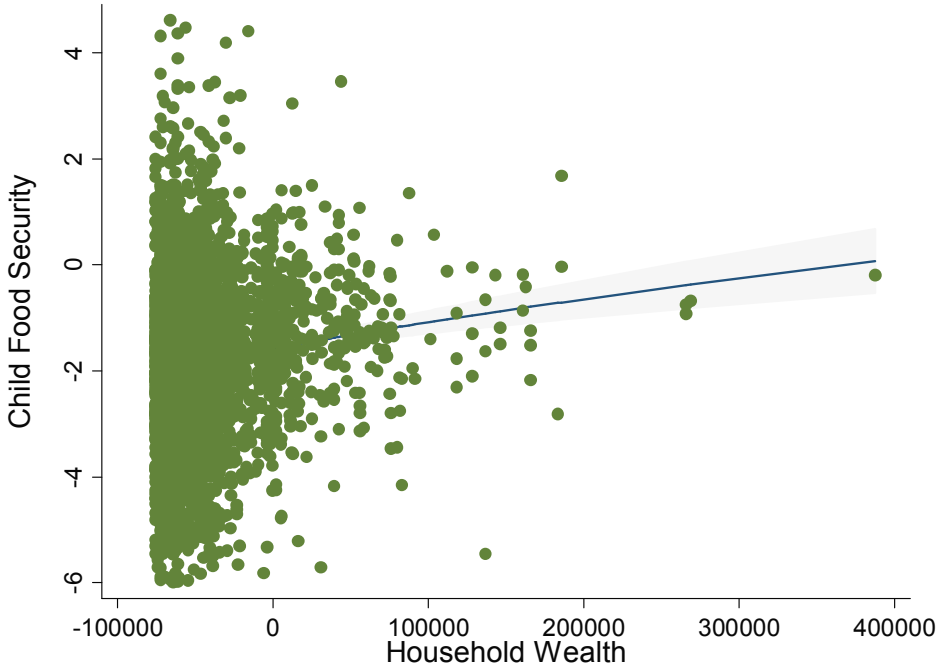
Figure 2 offers basic, but interesting information on one important issue: is it true in the case of Mozambique that when rural households are wealthier children are more likely to be food secure? This is an important question especially in the light of Amartya Sen's argument that income is an instrument of development, while matters such as children's nutrition are ends of development. The relationship between these two factors is likely to be positive and evident, but it depends on how rural households use their economic resources for something valuable such as children's nutrition. The graph seems to provide a positive answer to this question. The regression line has a positive inclination, although not very marked.

Figure 1. Relationship Rural Mothers' Education – Rural Children's Food Security




0 = no education; 1= Some Primary; 2 = Complete primary; 3 = Some Secondary; 4= Complete secondary/higher

Figure 2. Relationship Rural Households' Wealth – Rural Children's Food Security



## 6. Econometric Results

Table 3 in Annex 2 shows the results of the different stages of econometric estimations.

In column (1) estimations have been made without the inclusions of the pathways of influence. Education for rural mothers has a fundamental role in enhancing rural children's food security. A child with a mother who has attended some years of primary school has a significant higher probability to be food secure than a child with no education at all. More important, a child whose mother has completed seven years of primary school is far more likely to be food secure than a child whose mother has only some years of schooling. Things change when we move to higher levels of education. Having some years of secondary education does not seems to be a characteristic of rural mothers that provides further benefits to child nutrition. However, completing secondary schooling is essential: its coefficient is highly significant (p-value < 0.001) and the intensity of its influence very large (coefficient = 0.963).

Models in column (2) and (3) are constructed adding respectively only the wealth index and the wealth index together with the indicator for mother's access to media.[17] Both the new factors are significant predictors of child nutrition. Their inclusion does not drastically modify the coefficients associated to the education variables: compared to column (1), in column (3) "some primary" and "complete primary" decrease respectively by 12.7 percent and by 19.6 percent. To the opposite, the coefficient associated to "complete secondary or above" rises by 19 percent. As expected, the addition of the two "channels" caused a change in the influence of mother's education; however this change is not so radical and varying according to the level of education.

Finally, model in column (4) is the final one since it incorporates the interaction terms between education and the two identified channels. This model helps to understand the interactive mechanisms between mother's education and child food security.

The most important change concerns complete secondary education: from highly significant the variable has been now dropped. At the same time, the cross-term between secondary education and the wealth index is significant and its contribution to child food security is positive.[18] This means that rural mother's complete secondary education is important for child food security, but it does not act directly. It acts only by raising household wealth.[19]

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[17] In section 3, we argued from a theoretical perspective that mother's access to media could be endogenous because it reflects unobserved nutrition knowledge. This would imply the use of 2SLS estimator. However, the Wu-Hausman test applied once the variable *Accessmedia* has been instrumented with the availability of radios and/or TVs, showed that the null hypothesis of exogeneity of the variable cannot be rejected at 0.1 significance level. That is why, in column (3) and (4) of table 3 we have simple OLS estimates rather than 2SLS estimates.

[18] The negative sign should not be misleading: the mean value of the wealth index is , in fact, negative.

[19] The precise impact is not quantifiable due to the measurement units of the wealth index. However, it should be considered that secondary education could partly act as a proxy of wealth and that the

Regarding the dummy "incomplete primary", its influence remains approximately the same, while the influence of "complete primary" increases. The interaction term between primary education and access to information, instead, is not statistically significant.

The main results that this econometric study suggests are highlighted in figure 3. Figure 3 shows the type and the strength of the linkages between rural mother's educational attainments and rural children food security.

As a conclusion from this estimate, we can argue that rural children whose mothers have completed the whole cycle of primary school have, on average, approximately 0.6 height standard deviations more than rural children whose mothers have only some years of primary school, and 0.7 height standard deviations more than rural children of mothers with no education.[20] Subjects studied directly in school together with general abilities acquired in class seem to be essential determinant of child food security. On the other hand, rural mother's primary education seems to act also through access to nutrition and health information in order to reduce children food security, but this channel is likely to be further mediated by another channel such as basic literacy.[21]

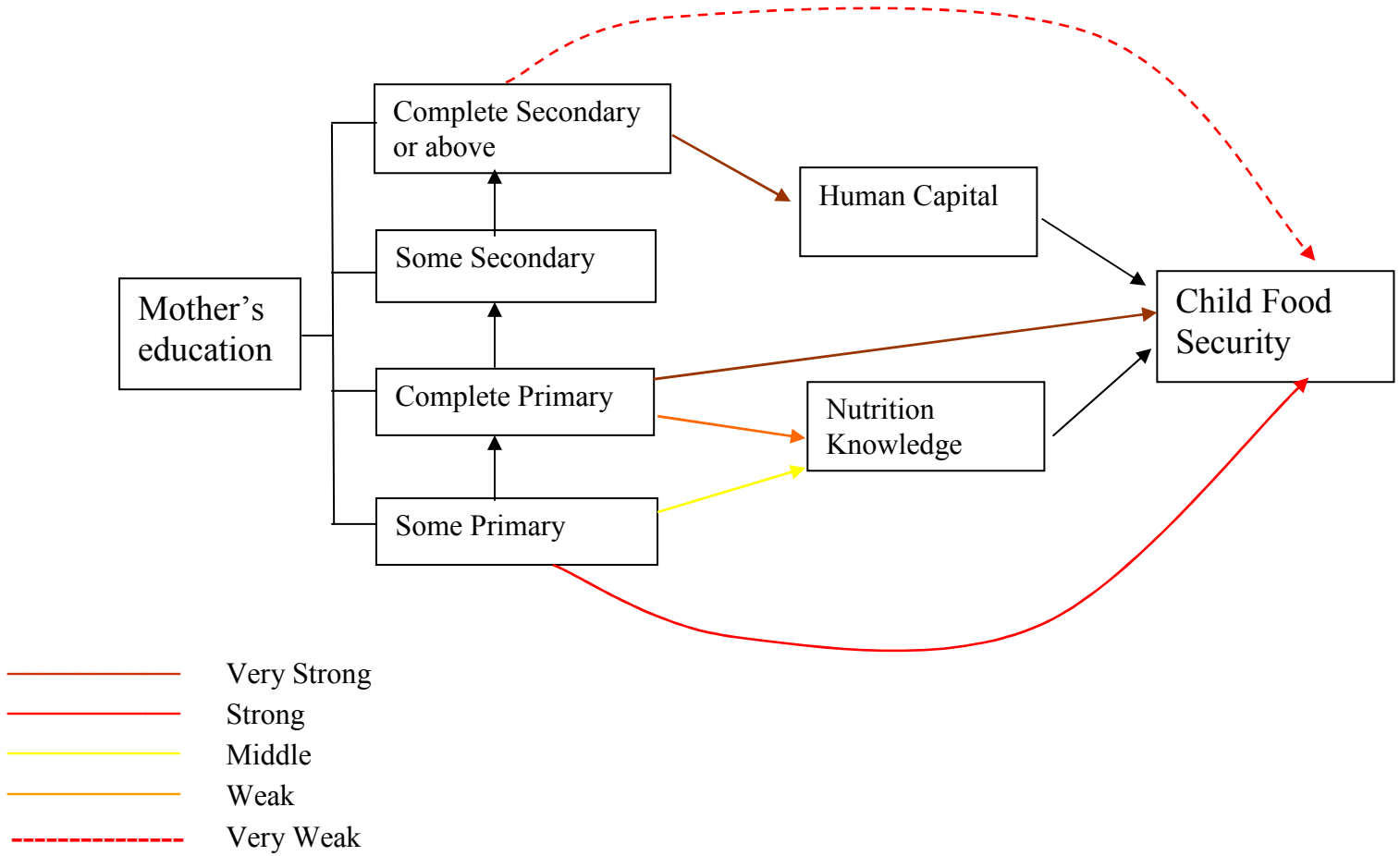
Regarding other determinants of child food security, all the models show that father's schooling, mother's nutrition and the fact that the woman (mother) is currently married are significant positive predictors. On the contrary, household size and child's age have a negative influence on child food security.

inverse relationship, through which wealth affects mother's education, although limited is unlikely to be zero (dashed line in figure 1).

[20] In order to understand the extent of this influence, it should be always kept in mind that a child with -2 SD from the WHO reference population is considered moderately malnourished.

[21] Although the interaction term is not statistically significant, the inclusion of the variable *Accessmedia* in column (3) causes a change in the coefficients of education variables. Such an influence, anyway, is not very strong.

**Figure 3. Actual channels through which higher levels of rural mothers' education provide further benefits to rural children food security**



## 7. Conclusions

A large percentage of Mozambican population suffers from food insecurity, and the vast majority lives in rural areas. Within overall rural food insecurity, a special concern should be given to pre-school age rural children since they should be the main actors of socio-economic development of the country in the close future. DHS data from 2003 survey highlights that around 40 percent of children are moderately stunted[22] and 17 percent of them are severally stunted.[23] This proportion is even more dramatic among rural children since more than 45 percent of them are moderately stunted and 20 percent are severally stunted. These data call for urgent policies aiming to fight rural food insecurity. That is why this research intended to address this issue, by analyzing some key determinants of chronic food insecurity among rural children.

The main findings of this research are the following:

1. Rural mother's education is clearly an essential element to reduce rural food insecurity in Mozambique.

2. If mothers complete the whole cycle of primary education, this is likely to be reflected in lower probability of the child to fall into food insecurity trap. It was estimated that children with rural children whose mothers have completed primary schooling have, on average, around 0.6 height standard deviations more than rural children whose mothers have only some years of primary school, and 0.7 height standard deviations more than rural children of mothers with no education. The additional direct returns in terms of better nutrition of the child seem to be decreasing for levels of mother's education above primary education.

3. Once we consider also the indirect role played by mother's education, we realize that primary schooling keeps a significant large impact on child food security: this means that subjects directly studied in school and general knowledge acquired in class have a direct relevance. However, primary schooling provides also a fairly strong contribution by increasing nutrition and health knowledge, which are fundamental to improve child food security (*utilization* dimension of food security). Having some secondary education does not affect mother's capacity to influence child's nutrition, but completing the whole secondary school does have an impact. Such an impact occurs indirectly, through the increase of household income, which if finally converted in larger probability of the child to be food secure. Thus, this channel contributes to the *economic access* dimension of food security.

In terms of policy, these findings suggest that investing in quality education of rural women could be an effective policy to reduce long-term child food insecurity. An additional policy recommendation arising from this study is that, in Mozambique it seems better to reduce disparities in access to primary education, rather than promoting secondary education for a small part of the population. In strictly economic terms, rural food insecurity of children below five can be better fought

[22] Height-for-age is at least 2 standard deviations lower than the level in the reference WHO population.
[23] Height-for-age is at least 3 standard deviations lower than the level in the reference WHO population.

giving incentive to one illiterate woman to join a primary school course rather than giving incentive to one woman with complete primary education to access secondary education.

To the opposite, simply providing rural people with food or assets, or applying an income transfer is likely not to ensure a radical reduction of children's chronic food insecurity. Food provision can be crucial for short-term crisis, but much less for alleviating chronic food insecurity.

The result is that education for mothers is a key to tackle children food insecurity within rural households. Furthermore, since rural population counts for 64.4 percent of overall Mozambican population (IFAD 2003), education for rural mothers can be considered as a key policy to address the problem of long-run food insecurity in Mozambique.

Finally, Mozambique presents characteristics typical of other low-income countries: low levels of school participation, high incidence of poverty and food insecurity, high concentration of population in rural areas and high incidence of poverty among rural people. This is why policies such as those suggested in this paper, aiming to tackle hunger and food insecurity, and achieving MDGs, are likely to work also in other countries.

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# Annex 1.
# Indicator of Mother's Access to Media

Starting from the original DHS dataset it is possible to obtain information about the capacity of mass media to increase people's knowledge on certain social and health issues. In particular, it is clear that most of the information concerning diseases such as AIDS is obtained primarily through radios, and then also through televisions. Furthermore, Government-led programmes for the dissemination of nutrition and health knowledge are mainly channelled through the most used instruments, which also in remote rural areas of Mozambique are the radios. Therefore, we create an indicator with the reasonable assumption that a person frequently listening to radios is more likely to acquire this type of knowledge than another person frequently watching TV.

The final index is constructed in the following way. Counting on the above assumption, the indicator *Accessmedia* has a higher value if the woman only listens to radio rather than only watching TV. Thus, for example listening to radio at least once a week (Radio = 2) is assumed to count as well as watching TV more than once a weak (TV = 3). Regarding possible combinations of different sources, the rationale is that the indicator takes a lower value than the simple sum of the value for each source because the information obtained in multiple ways is likely to partially overlap.

All the modalities are reported below.

Accessmedia = 1.5 if Radio = 1 and TV = 0
Accessmedia = 1 if Radio = 0 and TV = 1
Accessmedia = 3 if Radio = 2 and TV = 0
Accessmedia = 2 if Radio = 0 and TV = 2
Accessmedia = 4.5 if Radio = 3 and TV = 0
Accessmedia = 3 if Radio = 0 and TV = 3
Accessmedia = 2 if Radio = 1 and TV = 1
Accessmedia = 4 if Radio = 2 and TV = 2
Accessmedia = 7 if Radio = 3 and TV = 3
Accessmedia = 5 if Radio = 3 and TV = 1
Accessmedia = 6 if Radio = 3 and TV = 2
Accessmedia = 4 if Radio = 1 and TV = 3
Accessmedia = 5 if Radio = 2 and TV = 3
Accessmedia = 3.5 if Radio = 2 and TV = 1
Accessmedia = 2.7 if Radio = 1 and TV = 2

Where both the original variables – radio and TV – have the modalities:
0 = not at all
1 = less than once a week
2 = at least once a week
3 = more than once a week

# Annex 2
# Econometric Estimates

Table 3. Determinants of Rural Children's Food Security [a]

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | OLS | OLS | OLS | OLS |
| Dependent variable: Child Food Security (Height-for-age Z-score) | Overall education effect | Add the Wealth Index | Add exogenous *Accessmedia* | Add Interaction Terms |
| Constant | -2.698*** | -2.390*** | -2.502*** | -2.297*** |
| | (0.622) | (0.635) | (0.637) | (0.569) |
| ***Child Characteristics*** | | | | |
| Child sex (female=1) | 0.058 | 0.057 | 0.056 | 0.056 |
| | (0.039) | (0.039) | (0.039) | (0.039) |
| Child age (in months) | -0.020*** | -0.020*** | -0.020*** | -0.020*** |
| | (0.001) | (0.001 | (0.001) | (0.001) |
| ***Mother Characteristics*** | | | | |
| Mother's age: 15-24 | -0.100 | -0.106 | -0.107 | -0.107 |
| | (0.068) | (0.069) | (0.068) | (0.068) |
| Mother's age: 25-29 | 0.035 | 0.029 | 0.028 | 0.026 |
| | (0.069) | (0.070) | (0.070) | (0.070 |
| Mother's age: 30-34 | 0.075 | 0.070 | 0.073 | 0.073 |
| | (0.071) | (0.071) | (0.071) | (0.071) |
| Mother's age: 35-39 | Dropped | Dropped | Dropped | Dropped |
| Mother's age: 40-49 | 0.088 | 0.088 | 0.085 | 0.086 |
| | (0.087) | (0.086) | (0.087) | (0.087) |
| Mother's age at first birth | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Mother is currently married | 0.206*** | 0.194** | 0.177** | 0.176** |
| | (0.076) | (0.077) | (0.077) | (0.077) |
| Mother has some primary education | 0.118*** | 0.112** | 0.103** | 0.102** |
| | (0.043) | (0.043) | (0.044) | (0.044) |
| Mother has completed primary education | 0.366** | 0.301** | 0.294* | 0.596** |
| | (0.153) | (0.151) | (0.153) | (0.249) |
| Mother has some secondary education | -0.094 | -0.117 | -0.107 | -0.112 |
| | (0.245) | (0.252) | (0.251) | (0.252) |
| Mother has at least completed secondary education | 0.963*** | 1.076*** | 1.146*** | Dropped |
| | (0.224) | (0.236) | (0.237) | |
| Mother Height-for-Age Z-score | 0.002*** | 0.002*** | 0.002*** | 0.002*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Mother BMI | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |

| | | | | |
|---|---|---|---|---|
| Mother's Access to Information (*Accessmedia*) | — | — | 0.023** | 0.026** |
| | | | (0.011) | (0.011) |
| ***Father Characteristics*** | | | | |
| Father's Years of Schooling | 0.024*** | 0.021*** | 0.020** | 0.020** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| ***Household Characteristics*** | | | | |
| Household size | -0.013* | -0.015*** | -0.015*** | -0.015*** |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Household members < 5 | 0.249 | 0.276 | 0.286 | 0.291 |
| | (0.181) | (0.181) | (0.181) | (0.181) |
| Household wealth index | — | 0.000*** | 0.000** | 0.000** |
| | | (0.000) | (0.000) | (0.000) |
| ***Context Characteristics*** | | | | |
| Availability of Electricity | 0.257 | 0.227 | 0.236 | 0.198 |
| | (0.559) | (0.559) | (0.559) | (0.553) |
| Sanitation | 0.374 | 0.185 | 0.246 | 0.537 |
| | (0.844) | (0.848) | (0.848) | (0.810) |
| Bad Health Environment | 0.596 | 0.600 | 0.612 | -0.541 |
| | (0.886) | (0.886) | (0.883) | (0.377) |
| Educational Environment | 0.305 | 0.244 | 0.234 | 0.170 |
| | (0.192) | (0.193) | (0.193) | (0.198) |
| Interaction: Compl. Primary – Accessmedia | — | — | — | -0.080 |
| | | | | (0.064) |
| Interaction: At least Compl. Secondary – HH wealth | — | — | — | -0.000** |
| | | | | (0.000) |
| R-Square | 0.132 | 0.133 | 0.134 | 0.135 |
| Wald Test for joint significance: | | | | |
| 1. Some Primary - Wealth | — | F-St = 8.04*** | F-St = 5.52*** | — |
| 2. Compl. Primary - Wealth | — | F-St = 6.76*** | F-St = 4.82*** | — |
| 3. Some Secondary - Wealth | — | F-St = 4.33** | F-St = 2.66** | — |
| 4. At least Compl. Secondary - Wealth | — | F-St = 12.90*** | F-St = 13.17*** | — |
| 5. Some Primary - Accessmedia | — | — | F-St = 5.46*** | — |
| 6. Compl. Primary - Accessmedia | — | — | F-St = 3.96** | — |
| 7. Some Secondary - Accessmedia | — | — | F-St = 2.11 | — |
| 8. At least Compl. Secondary - Accessmedia | — | — | F-St = 12.38*** | — |

*** = significant at 0.01-level, ** = significant at 0.05-level, * = significant at 0.10-level.
Sample size = 4,776 children.
Robust standard errors in parenthesis.
a. 11 dummy variables for Provinces omitted.