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Undernourishment in North and Sub-Saharan Africa

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Abstract

Undernourishment has continued to occur globally in recent years; the spread of this phenomenon shows that inequalities, between and within countries, are increasing. After a good period of stability since 2015, the prevalence of undernourishment (PoU) dropped from 8.0 percent to 9.3 percent between 2019 and 2020, then increased at a less sustained rate in 2021, rising to 9.8 percent. The causal factors to eliminate or reduce its severity differ from one country to another. The causes of hunger in the countries of North Africa are: independence from food imports of primary products, loss of marine biodiversity, climate change (projected change in warm periods) and poverty in terms of available water resources cause while malnutrition or moderate food insecurity comes down to the lack of commitments in international conventions on the environment and the respect and enforcement of the law against trafficking in natural resources.The causal variables of these two phenomena in the countries of sub-Saharan Africa are identical.The great pressure that the population exerts on their environment and the enormous consumption of resources without having them protected, also the total deterioration of the agricultural sector and the Emigration to urban areas has greatly worsened the situation of hunger and malnutrition in these countries.The projects implemented to resolve these issues must be designed according to the causes identified in each country.In general, the reorientation of public support must currently be provided to strengthen the primary sector (food and agriculture), by implementing complementary policies relating to agri-food systems, promoting healthy food environments and providing consumers with the means to adopt a healthy diet.

Keywords: *North and Sub-Saharan Africa, Food Security.*

Introduction

The world today finds itself facing a problem despite hopes of an end to undernourishment and a start to improve food security.Malnutrition and even hunger still occurs in most countries. The circumstances that the world has experienced in recent years such as the COVID 19 pandemic, the war between Ukraine and Russia and especially climate change have worsened the situation in the food sector.

A lot of support provided by the public sector in order to save food and agriculture but it remains insufficient.We must necessarily have complementary policies which encourage healthy eating.The excessively high costs of this type of nutrition and the remarkable deterioration of the purchasing power cannot help establish healthy food environments.

According to the 2030 Sustainable Development Goal, there are only seven years left to completely eliminate hunger and all forms of malnutrition, but on a practical level, we find that we are too far from these goals and the world is heading towards Wrong direction. Hunger still had a place in the world from 2019 despite having recorded such stability since 2015.The variable of the prevalence of undernourishment recorded a sharp increase in 2019 to reach 9.3 percent against 8.0 percent in 2015. We are then talking about an increase of 1.3 percentage points between 2015 and 2020. This increase was continued but at a slow pace between 2020-2021, an evolution of only 0.5%.

A strong inequality recorded today regardless of between countries or within each one. It must be said that the least developed countries are more affected than others by the problem of food insecurity. African countries are at the top of the list with one in five people experiencing undernourishment, almost 20% in 2021 suffering from hunger while the percentage in advanced countries is 2.5% lower but that is not the case. This prevents malnutrition from evolving but at different rates between and within countries.

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A significant part of aid is currently allocated to food and agriculture.The public authorities must direct all policies towards the achievement of food security, good nutrition and the total elimination of hunger. These objectives can only be achievable through the efficient use of public budgets to minimize the high costs of healthy food so that it is accessible to everyone. Consequently, and in relation to salary levels, they should raise awareness among people and direct them towards the consumption of organic products.

Food security is ultimately a responsibility of the public authorities, it is part of the general context of human rights.

Theoretical Consideration

Definition of Food Security

The concept of food security appeared in 1970.According to the Committee on World Food Security, several factors were at the origin of the appearance of this concept citing: the remarkable increase in the prices of cereals on international markets caused by a bad harvest season and the deterioration of agriculture, the shortage of oil stocks and the rise in these prices. At that time several regions were suffering from a lack of basic food products to feed the population because of the climate change (drought, global warming, etc.) as well as a total imbalance in the natural system. Thus the definition adopted by the World Food Conference in 1974 reflects this context: "To have at all times, an adequate level of basic products to satisfy the increase in consumption and mitigate fluctuations in production and prices. »

Theoretical Consideration

The risk factors for hunger mainly come down to the internal conditions that a nation can face, the lack of financial means to satisfy the basic needs of the population, the absence of hygiene and good manners and places to store food. These conditions can in turn sometimes lead to fatal illnesses.The isolation of a group of individuals in an unfavorable environment to habitation and who lack the necessary means to live in good conditions. The deterioration of the agricultural sector and the suffering of farmers are caused by the lack of means, whether financial or material.

Other factors of food insecurity may fall outside the responsibility of man or we can say that the latter's participation is indirect, such as the impact of climate change on production in all sectors and also pollution and its negative effects on the environment.

In this context, many other empirical works have been developed in this area to show the causes of hunger. Thomas Malthus showed that the relationship between demographic growth and the slowdown in the agricultural sector gives rise to a remarkable gap difficult to fill by the nation without having to make additional efforts. While Amartya Sen finds that the relationship between production and population is insignificant, a country with high production does not necessarily mean that it beats hunger, citing as an example of a country like China and India. These producing countries at the base and with a high growth rate, however cannot make hunger disappear. Time has shown that other countries have shown that it is not enough to produce enough food in a country or region to overcome hunger. Countries like India, Brazil and China have managed to produce enough food to feed their entire population, or even to export surpluses, without having made hunger disappear. On the other hand, other countries which do not resort to food production but benefit from oil revenues, feed their populations and completely eliminate hunger by resorting to the international market.

Over time the concept of food insecurity has been modified, which does not necessarily mean hunger but rather the quality of the diet and the number of calories obtained by the individual per day or over a given period. So it is not a problem to eat or not, but above all what to eat? In this context, the committee for world food security in 2012 adopts the integration of the concept of nutritional security; this proposal is based on the fact that malnutrition that has been recorded for a long time today causes food insecurity and diseases (diarrhea, malaria, lack of vitamins, etc.).

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In recent years and precisely since 2015, food insecurity affects a significant number of people and the situation has become more serious with the 2019 pandemic, the FAO (Food and Agriculture Organization) shows that around 702 million and 828 million people globally in 2021 suffered from hunger. The number recorded an increase of 46 million in 2021 compared to 2020, and an additional 105 million in 2020 compared to 2019.

According to the FAO, hunger refers to a feeling of physical lack caused by the insufficient quantity of energy received by the human body; it can often be painful and causes several diseases. The prevalence of undernourishment is the famous indicator used by the FAO for a long time to measure "hunger".

The prevalence of undernutrition "Is an estimate of the proportion of the population whose usual food consumption is insufficient to provide the levels of dietary energy required to maintain a healthy and active life. It is expressed as a percentage. It measures progress towards target 2.1. SDGs » FAO since 1974.

The individual is considered in a situation of food insecurity, if he does not have regular and daily access to nutritious food because of the lack of resources necessary to have it, but at this level the FAO has carefully distinguished between levels of hunger severity. We therefore distinguish between two levels, severe and moderate food insecurity:

Figure 1: Levels Of Food Insecurity FAO, IFAD, WHO, WFP And UNICEF. 2022.

Food insecurity refers to hunger when it reaches a too high level (going days without eating), otherwise we speak of moderate food insecurity when the individual is unable to achieve a balanced diet and have the healthy diet,that means he does not have access to sufficient protein and energy.

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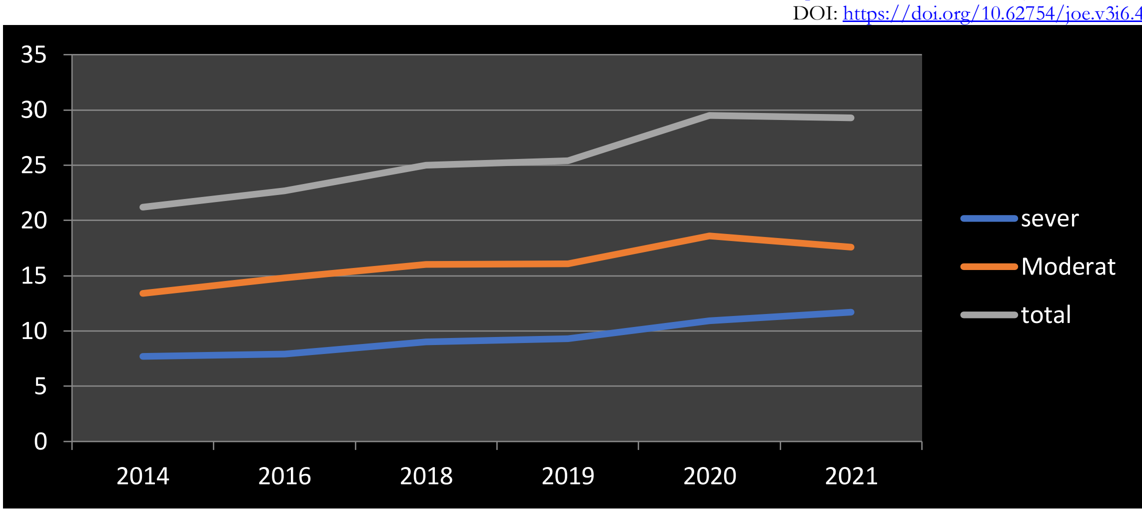
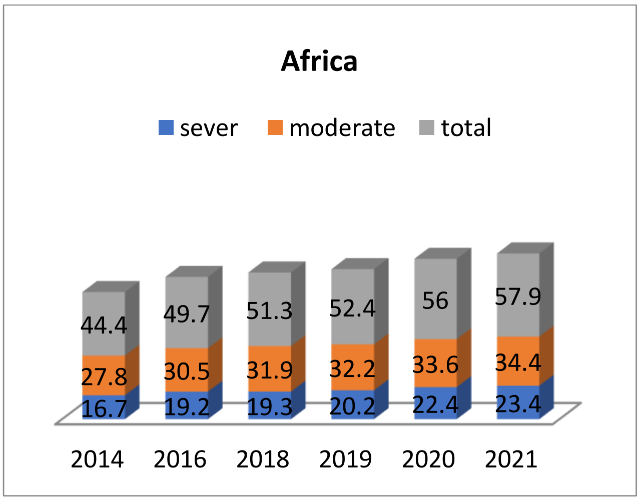


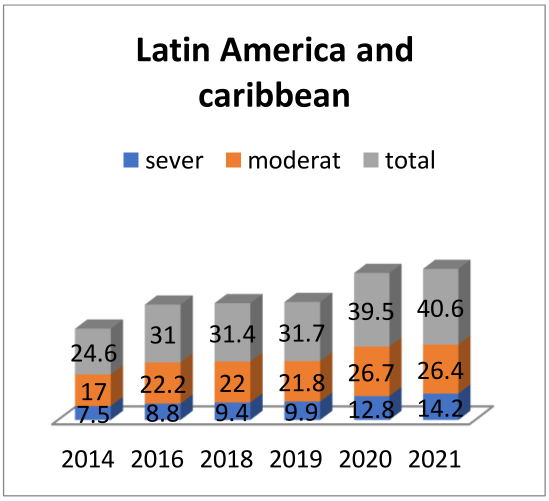
Figure 2: The Evolution of Severe and Moderate Food Insecurity in The World Over the Period 2014-2021 (Pou).

Over the period 2014-2021 hunger experienced a remarkable expansion, especially in terms of severe food insecurity.The situation became more serious with the events of covid-2019, the percentage of PoU rose by 2.4 percentage points between 2019-2021 so the rate increases from 9.3% to 11.7%.

Moderate food insecurity also increased but at a slower rate, only 1.5 percentage points. So the world has recorded a remarkable evolution in hunger, the overall rate increased by 5 percentage points over 2019-2021.The hunger rate in general increases from 25.4% in 2019 to 29.3% in 2021. What is happening in the world is totally far from the sustainable development objective which aims to completely eliminate hunger, a percentage of 0% in 2030. We can therefore say that this notion in the world is tending in the wrong direction. But it must be said that there is a strong disparity between regions and within them in terms of food insecurity and the causes of the latter differ from one place to another.

African countries suffer much more from the problem of hunger than others, a too high percentage of serious food insecurity exceeds 23.4% in 2021, the time that the countries of North America and Europe the percentage does not does not exceed 1.5%. A very remarkable disparity.





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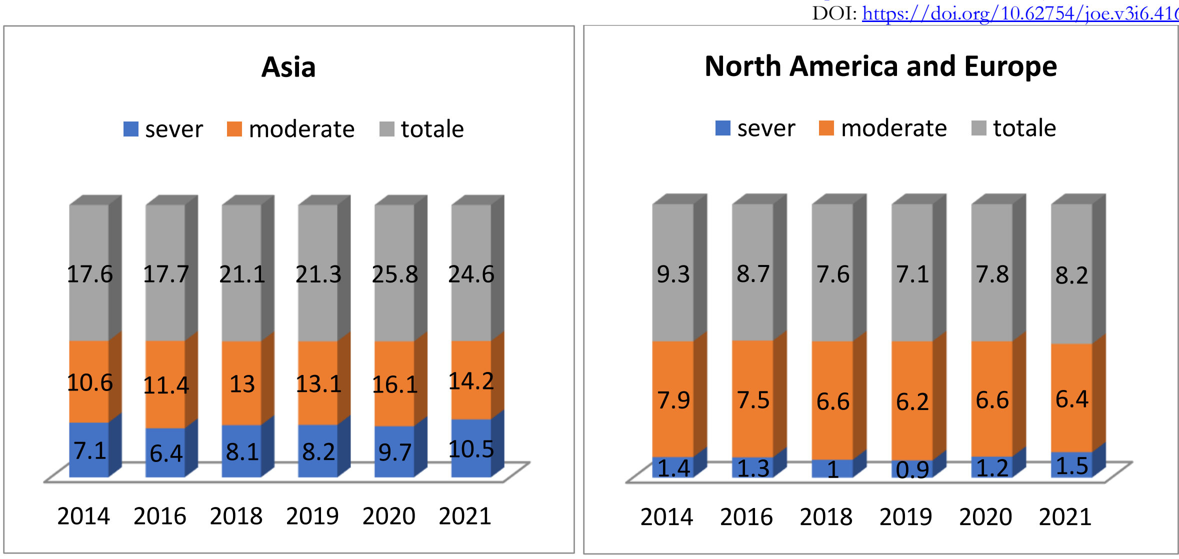

Figure 3: The Evolution of Severe and Moderate Food Insecurity in Africa, Asia, Latin America and The Caribbean and North America and Europe Over the Period 2014-2021 (Pou).

Hunger is highly prevalent in poor and developing countries compared to advanced countries. We find that Africa takes the first place in terms of severe and moderate food insecurity, the percentages in 2021 are respectively 23.4% and 34.4% . More than 50% of the population suffers from the problem of food insecurity. Although this phenomenon experienced a remarkable increase over the period 2014-2021 a total increase of around 14 percentage point. This critical situation and horrible spread of hunger are caused by multiple effects: we find, the multi-year droughts in the Horn of Africa and East Africa, the internal conflict in Ethiopia, a swarm of locusts. Also the last four years we are talking about international shocks associated with the pandemic and the war in Ukraine. Which subsequently causes an increase in unemployment, poverty and degradation of human capital.

The group of Latin American and Caribbean countries is in the second place with a much lower percentage compared to the African countries. A percentage of severe and moderate hunger of 14.2% and 26.4%, we speak of approximately 40% of the population suffering from food insecurity. The problem in this region is rather malnutrition and the lack of access to healthy food, problems in the functioning of agricultural and food services. This confirms that families have difficulty eating healthy and many children sometimes find themselves either hungry or overweight. For children to grow up healthy, they must ensure that all families have access to affordable and nutritious food.

Food insecurity is also found in Asia, it reaches 24.6% of the population in 2021 distributed between 10.5% who suffer from severe hunger and 14.2% from moderate hunger. These percentages have been increased very remarkably especially after the covid-19 pandemic. Furthermore, a remarkable slowdown in economic activity in Asia and the Pacific and economic contractions, have had a greater effect on the accessibility of food as the increase in food prices.

Hunger is almost absent in the countries of North America and Europe. In 2021, only 8.1% suffer from the problem of hunger, including 1.5% the percentage of severe food insecurity and 6.4% moderate. Also, the percentage is almost stable over the period 2014-2021, a slight and even negligible increase from 2019 of 0.6%. The problem in this country maybe in the access to healthy food, quantity of energy received per day etc.

These countries suffer less than others from the problem of people not having regular access to healthy, nutritious and sufficient food. The food security is due to the strong legislative frameworks that provide an enabling environment to minimize hunger across the approval of laws and budgets regarding food and nutrition security.

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Model and Estimation

Undernourishment is a phenomenon that painfully affects human beings. This phenomenon is widely distributed in poor and developing countries compared to advanced countries. This empirical work takes into consideration the case of Africa since it has recorded the highest rates in terms of severe and moderate hunger according to the FAO classification. Our objective at this level is to know the causal variables of food insecurity, and the difference in terms of causality between the countries of North Africa and sub-Saharan Africa.

Empirical Model

Analysis Samples

The countries of Africa are the subject of our sample which includes 19 countries (data fault). The geographical distribution of the countries of Africa and their economic and environmental differences prompted us to break down the sample into two groups of countries (North Africa and sub-Saharan Africa).

Variables

In terms of variables, our model includes two endogenous or explanatory variables and fifteen exogenous variables. The analysis period extends from 2015 to 2021, i.e. 7 years.

Endogenous variables	Exogenous variables
Y1 : Prevalence of severe undernourishment	x1: water stress/x2: efficient use of water/x3:food price/x4:dependence on food imports/x5:Agriculture capacity/x6:projected change in biome distribution/x7:projected change in marine biodiversity/ x8:dependence on natural capital/x9:Ecological footprint/x10:commitment to international environmental conventions/x11:projected change in hot periods / x12:projected change in flood risk/ x13:Urban concentration/ x14:GDP /h/x15:protected biome
Y2: Prevalence of moderate undernourishment	x1: water stress/x2: efficient use of water/x3:food price/x4:dependence on food imports/x5:Agriculture capacity/x6:projected change in biome distribution/x7:projected change in marine biodiversity/ x8:dependence on natural capital/x9:Ecological footprint/x10:commitment to international environmental conventions/x11:projected change in hot periods / x12:projected change in flood risk/ x13:Urban concentration/ x14:GDP /h/x15:protected biome

Source: Data collected from the Food and Agriculture Organization of the United Nations. And the World Bank.

Models to Estimate

The existence of two endogenous variables necessarily requires two empirical models at the level of the first equation. We will test the effect of environmental and economic variables on severe food insecurity then their effects on moderate food insecurity.

Analysis Hypotheses

H1: a difference in terms of causality exists between the two levels of food insecurity (severe and moderate).

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H2: the causes of undernourishment in North African countries are different from those in sub-Saharan African countries.

Equations

Severe food insecurity — Moderate food insecurity

$$Y1_{it} = \alpha_i + \sum \beta x_{it} + \dot{\varepsilon}_{it} \qquad Y2_{it} = \alpha_i + \sum \beta x_{it} + \dot{\varepsilon}_{it}$$

of which :i=1…..19 — **of which: i=1…..19**

t=2015….2021 — **t=2015….2021**

Empirical Investigations

Severe Food Insecurity

Severe Food Insecurity in African Countries

Variables	Coefficients	p-value
x9: Ecological footprint	1. 07	0. 002
x11projected change in hot periods	0.761	0.033
x13: Urban concentration	0. 682	0.071
x15: protected biome	1.889	0.008

Source: Author's Calculation

Interpretation

Most African countries suffer from environmental problems such as temperature instability and fluctuating precipitation which subsequently causes natural disasters that hit the population hard. Theterm «yukiotanaka" often refers to people who died because of this phenomenon in the Horn of Africa, the drought causes a famine which has cost the lives of a significant number of inhabitants. Also in East Africa especially the countries which are located at the level of the Nile basin, suffered catastrophic floods which affected up to millions of people in 2020.The drought of these countries is an obstacle to the crop cycle and livestock breeding and generally to any investment in nature which is caused by the continuation of the vicious circles of serious hunger. The deterioration of the agricultural sector and the worsening of the food insecurity situation are pushing people to move to urban areas, that is why our empirical work shows the positive effect of the variable of urban concentration on insecurity. The severe food crisis, leads to an increase in the rate of urbanization in Africa increases from 15% in 1960 to 40.43% in 2015 and it is expected to reach more than half of the population in 2035. Most theories find that urbanization has only improved the standard of living of the population, but according to "Bruno Emmanuelongo and Jacque Simon Song" this situation in Africa has not only increased pressure on housing, but also deterioration in the standard of living and the development of slums, poverty as well is increasing. All these problems lead obviously to severe food insecurity and hunger. Turok (2012) in his way finds that the relationship between urbanization and economic development in African countries is purely negative and the latter can only worsen the hunger situation.

Still speaking in the environmental context, we can confirm that the great pressure of the rapid demographic expansion and the remarkable degradation of the ecosystem exerting on the environment, push the world to react immediately to protect natural spaces because the positive ecological footprint can help decrease the severity of huger. Despite the efforts made by African countries to conserve parts of their territories according to VICN (2.4 million km2 approximately 5.2% of protected areas), but it still

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remains insufficient given the value that the fauna and flora of these countries carry, and the poorly exploited renewable resources. This is why our results show a positive effect of protected biome on serious food insecurity, the integration of these resources into economic activity can improve the standard of living of the population because it represents sources of income in several areas, tourism (areas to visit, sports hunting etc.), commercial (artisanal products to market and also good quality of consumer products such as meat and fish), celestine Mengue-medou (2002). Therefore the protection of the natural resources of these countries and its proper exploitation in economic activity seems an obstacle to the risk of serious food insecurity of these populations.

Serious Food Insecurity in North African Countries

Variables	Coefficients	p-value
X1 water stress	0.094	0.066
x7: projected change in marine biodiversity	1.492	0.000
x9: Ecological footprint	-3.159	0.095
X2: efficient use of water	-0.29	0.002
x11: expected change in hot periods	6.556	0.002
x12: predicted change in flood risk	-12.943	0.004
x4: dependence on food imports	1.361	0.001

Source: Author's Calculation

Interpretation

The countries of North Africa are among the regions affected by serious food insecurity. The causes of the spread of this phenomenon return according to our empirical work to economic factors such as:dependence on food imports which has a direct effect of this variable on hunger. Dependence on national markets in these countries is also too important in terms of the most consumed primary products such as cereals, oil, etc. The percentage in 2018 according to Jacques Berthelot is 29%.

In the environmental context, the loss of marine biodiversity, climate change (expected change in hot periods) and the availability of water resources represent the three major evils which affect serious food security in the countries of North Africa. However, this groupof countries find themselves a little bit protected until now, compared to other African countries in terms of hunger because of the efficient use of water in these countries. Our work shows that the variable of the efficient use of Water in these countries has a negative effect on severe food insecurity. The ecological footprint of an individual depends on their lifestyle and the pressure that a person can exert on the earth. It must be said that this variable does not directly cause hunger in the countries of North Africa, knowledge and reduction of the ecological footprint can improve the food security situation; therefore, this variable has a negative effect on hunger. It is true that the risk of flooding is global but it must be said that the countries of North Africa are the least affected by the risk of flooding compared to the others, that is why this variable minimizes hunger or helps at least to cope with its increase.

Severe Food Insecurity in Sub-Saharan African Countries

Variables	Coefficients	p-value
X9: Ecological footprint	0.967	0.019
x12: predicted change in flood risk	1.132	0.007

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x13: Urban concentration	1.204	0.022
X4: dependence on food imports	3.273	0.007
X10: commitment to international environmental conventions	-10.474	0.000
X15: protected biome	10.912	0.000

Source: Author's Calculation

Interpretation

Hunger in sub-Saharan African countries is much higher compared to that in North African countries and this comes down to dependence on food imports of which these countries occupy the first place in terms of imports of food products. The percentage is 32.7% that early means half of Africa's total imports.Therefore, improving the productivity of agricultural labor is a necessity today in order to minimize hunger in Africa. The environmental pillar also poses a major problem with regard to the spread of hunger. The need to preserve savannahs and forests to mitigate this change and protect biodiversity is a priority in order to minimize serious food insecurity in the countries of the Sub-Saharan Africa. A positive effect of the protected biome variable on severe food insecurity, also that of predicted change in the risk of flooding which destroys the lives and land of a significant number of the population. The demographic pressure in these countries compared to the low level of development also poses a big problem with regard to the increase in hunger which is not really the case in the countries of North Africa.We observe here a positive effect of the ecological footprint on hunger. Also the variable of urban concentration has a positive effect on the variable of serious food insecurity. In SSA countries, the diffusion of the phenomenon of urbanization causes pressure on housing, a deterioration in standard of living , development of slums and poverty increase which obviously cause serious food insecurity and hunger. Thisproblem does not directly concern the countries of North Africa where the results showed no effect of this variable on the food insecurity.

The presence of international conventions on the environment is the only protection today in SSA against hunger, but it remains insufficient compared to the situation of serious food insecurity affecting this region. A negative effect of the variable of commitment to international environmental conventions on hunger.

Moderate Food Insecurity

Moderate Food Insecurity in African Countries

Variables	Coefficients	p-value
X4: dependence on food imports	0.261	0.013
x9: Ecologicalfootprint	-2.398	0.013
X12: predicted change in flood risk	-3.057	0.017
x11: expected change in hot periods	-3.497	0.017
x13: Urban concentration	0.468	0.055
x15:protected biome	-3.510	0.000

Source: Author's Calculation

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Interpretation

The explanatory indicator of the level of moderate food insecurity in African countries mainly comes down to the low level of income from agriculture which necessarily pushes the population to move towards urban areas. We can confirm therefore that the urban concentration has a positive effect on moderate food insecurity. Dependence on food imports of primary products especially is a resulting effect of the degradation of agriculture which subsequently causes an unsatisfactory diet.

Intervention by public authorities to implement agricultural modernization policies is a priority today in order to increase household income on the one hand and on the other hand improve the quality of agricultural products so that these countries can put on the market products. Consequently, this can guarantee a healthy nutritional balance and eliminate the shortage of necessary food products.

We note here that the variables that cause moderate food insecurity are different from those that cause hunger, a negative effect of the ecological footprint, expected a change in flood risk, expected change in hot periods and protected biome. These variables do not directly cause food shortages and poor nutrition, but it must be said that our results have already shown that they cause hunger.

Moderate Food Insecurity in North African Countries

Variables	Coefficients	p-value
X1 water stress	-0.065	0.050
X4: dependence on food imports	0.507	0.012
x7:projected change in marine biodiversity	1.543	0.003
x8:dependence on natural capital	1.133	0.000
x9: Ecologicalfootprint	-2.338	0.013
x10:commitment to international environmental conventions	22.110	0.041
x11: expected change in hot periods	-0.642	0.000
x12: predicted change in flood risk	-4.222	0.056
X15:protected biome	-7.128	0.099
X2: efficient use of water	-0.081	0.089

Source: Author's Calculation

Interpretation

The insufficiency in terms of energy and healthy food in the countries of North Africa mainly comes down to the dependence on food imports. This variable which causes hunger in these countries also affects malnourished people and causes insufficiency in terms of food. healthy eating, a positive effect of dependence on food imports on moderate food insecurity.

Commitments to international conventions on the environment , respect and enforcement of the law against trafficking in natural resources poses a problem throughout Africa, including North Africa, which necessarily causes a positive effect of the projected change in marine biodiversity on food insecurity and total disruption in the marine riches which represent the source of healthy and nutritious food. The

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dependence on natural capitals in these countries against the decline of biodiversity requires the immediate intervention of power, resident populations and local communities in order to monitor the application of existing laws. In addition, they must put in place new measures to protect and improve the future of certain animals and plants based on nutrients, and especially the creation of organic and sustainable agriculture programs in order to ensure healthy foods rich in vitamins and energy

Moderate Food Insecurity in Sub-Saharan African Countries

Variables	Coefficients	p-value
x7: projected change in marine biodiversity	1.057	0.020
x9: Ecologicalfootprint	0.406	0.030
x12: predicted change in flood risk	0.614	0.018
x13: Urban concentration	0.550	0.010
x15:protected biome	5.364	0.000
X10:commitment to international environnemental conventions	-5.149	0.000
X4: dependence on food imports	1.430	0.022

Source: Author's Calculation

Interpretation

At the level of the countries of sub-Saharan Africa the causal variables of hunger in these countries are almost the same which causes moderate food insecurity, a positive effect of the ecological footprint. There's a great pressure as well exerted by the population on their environment necessarily generated by a large consumption of natural resources by man without having the protected or renewed loss of healthy foods. Theseproblems also justified by the urban concentration and the deterioration of the agricultural sector: There's less and less food, which generates subsequently countries that are necessarily dependent on food imports in order to satisfy the minimum of their needs. Still in the environmental context, the lack of protected areas which can guarantee the survival of fauna and flora associated with projected change in marine biodiversity and anticipated change in flood risk can only aggravate the situation of food insecurity and hungry as we have already shown. Corrective measures are necessary today in order to put in place effective policies to protect the environment such as commitment to international conventions on the environment and especially the application of the law.Note that this variable is the only one which can have a direct negative effect on moderate and severe food insecurity. The development of the agricultural sector is one of the most powerful levels on which we must act to put an end to malnutrition.

Conclusion

The problem of food insecurity, whether serious or moderate, is a major force affecting African countries. The problem is the same but the causes differ from one region to another. The causes of hunger in North African countries are dependence on food imports of primary products, which makes prices necessarily high in relation to the purchasing power of the population. In the environmental context, the loss of marine biodiversity, climate change (expected change in hot periods) and poverty in terms of available water resources are causing hunger in one way or another in these countries. The causes of malnutrition are different from those of hunger.Our work shows that commitment to international conventions on the environment and respect and enforcement of the law against trafficking in natural resources is among the major problems of moderate food insecurity, which confirms our first hypothesis.

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Severe and moderate food insecurity in sub-Saharan African countries is represented in the form of a single problem with the causes and solutions being identical. Hypothesis 1 invalidated "a difference in terms of causality exists between the two levels of food insecurity (severe and moderate)". The great pressure that the population exerts on their environment and the enormous consumption of resources without having the protected ones, also the total deterioration of the agricultural sector and the emigration towards urban areas have greatly aggravated the situation of hunger and malnutrition in those countries.

We can therefore conclude that the solutions to undernourishment must be adopted according to the causes because they differ from one region to another, which confirms our second hypothesis "the causes of undernourishment in the countries of the "North Africa is different from those in sub-Saharan African countries.

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Annex

Errorautocorrelation test

```
. correlate x1 x2 x3 x4 x5 x6 x7 x8 x9 x10 x11 x12 x13 x14 x15
(obs=132)
```

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15
x1	1.0000														
x2	-0.0816	1.0000													
x3	-0.0234	0.2369	1.0000												
x4	0.6557	-0.1614	-0.1822	1.0000											
x5	-0.1872	0.0779	0.2061	-0.5524	1.0000										
x6	-0.0020	0.1844	0.0211	-0.2797	0.0624	1.0000									
x7	0.5777	-0.0038	-0.0458	0.5352	-0.4252	-0.2301	1.0000								
x8	0.5777	-0.0038	-0.0458	0.5352	-0.4252	-0.2301	1.0000	1.0000							
x9	0.6601	0.0660	-0.0471	0.6173	-0.4157	-0.0934	0.4652	0.4652	1.0000						
x10	-0.0219	-0.1986	0.1567	-0.3740	0.5588	-0.1554	-0.0933	-0.0933	-0.3631	1.0000					
x11	-0.4638	0.3462	0.1646	-0.5860	0.4690	-0.1471	-0.1304	-0.1304	-0.3740	0.2648	1.0000				
x12	-0.3935	0.1436	0.1561	-0.6227	0.3959	0.4045	-0.6560	-0.6560	-0.4111	0.1582	0.1653	1.0000			
x13	0.5410	0.0910	-0.0383	0.4699	-0.1125	-0.1597	0.7383	0.7383	0.4938	-0.0599	-0.1714	-0.7289	1.0000		
x14	0.8618	-0.0189	-0.0784	0.8010	-0.4795	-0.0736	0.6993	0.6993	0.7667	-0.2798	-0.5974	-0.6276	0.7014	1.0000	
x15	-0.3356	-0.0984	0.0570	-0.4693	0.5209	-0.1131	-0.5746	-0.5746	-0.5581	0.4632	0.3919	0.5458	-0.6338	-0.6819	1.0000

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Severe Food Insecurity in African Countries (Global Sample)

```
. xtreg ln_y1  ln_x1  ln_x2  ln_x3  ln_x4  ln_x5, re

Random-effects GLS regression                   Number of obs      =        14
Group variable: p                               Number of groups   =         6

R-sq:  within  = 0.0249                         Obs per group: min =         1
       between = 0.9272                                        avg =       2.3
       overall = 0.6488                                        max =         4

                                                Wald chi2(5)       =     14.78
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0114

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |   .0751705   .1499305     0.50   0.616    -.2186878    .3690289
       ln_x2 |  -.4388872   .1166666    -3.76   0.000    -.6675496   -.2102249
       ln_x3 |   .2748058   .2740126     1.00   0.316     -.262249    .8118605
       ln_x4 |   .6950617   .4305733     1.61   0.106    -.1488466     1.53897
       ln_x5 |   .7891683    1.71342     0.46   0.645    -2.569074     4.14741
       _cons |   2.003764   .6924702     2.89   0.004     .6465469     3.36098
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .29554638
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y1 ln_x6  ln_x7  ln_x9  ln_x10  ln_x11  ln_x12, re

Random-effects GLS regression                   Number of obs      =       112
Group variable: p                               Number of groups   =        16

R-sq:  within  = 0.1375                         Obs per group: min =         7
       between = 0.3633                                        avg =       7.0
       overall = 0.3357                                        max =         7

                                                Wald chi2(6)       =     17.52
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0076

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x6 |  -1.912368   1.168562    -1.64   0.102    -4.202708    .3779723
       ln_x7 |   .7611434   .8371793     0.91   0.363     -.879698    2.401985
       ln_x9 |   1.078396    .345304     3.12   0.002     .4016127    1.755179
      ln_x10 |   1.206571   .7611118     1.59   0.113    -.2851806    2.698323
      ln_x11 |   .7618003   .3578881     2.13   0.033     .0603524    1.463248
      ln_x12 |    .113378   .5552067     0.20   0.838     -.974807    1.201563
       _cons |   5.583551   1.479073     3.78   0.000     2.684621    8.482482
-------------+----------------------------------------------------------------
     sigma_u |  .58969843
     sigma_e |  .21089029
         rho |  .88660743   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y1 ln_x13  ln_x14  ln_x15, re

Random-effects GLS regression                   Number of obs      =       133
Group variable: p                               Number of groups   =        19

R-sq:  within  = 0.2554                         Obs per group: min =         7
       between = 0.0147                                        avg =       7.0
       overall = 0.0162                                        max =         7

                                                Wald chi2(3)       =      9.09
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0282

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ln_x13 |   .6823232   .3780568     1.80   0.071    -.0586545    1.423301
      ln_x14 |   .1494692   .2131377     0.70   0.483    -.2682731    .5672114
      ln_x15 |   1.889744   .7151336     2.64   0.008     .4881076     3.29138
       _cons |   2.927519   1.820721     1.61   0.108    -.6410285    6.496067
-------------+----------------------------------------------------------------
     sigma_u |  .50821513
     sigma_e |  .20721291
         rho |  .85745562   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y1 ln_x1  ln_x2  ln_x8, re

Random-effects GLS regression                   Number of obs      =       118
Group variable: p                               Number of groups   =        17

R-sq:  within  = 0.0019                         Obs per group: min =         6
       between = 0.2454                                        avg =       6.9
       overall = 0.2291                                        max =         7

                                                Wald chi2(3)       =      1.30
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.7280

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |  -.0109945   .0248109    -0.44   0.658    -.0596231     .037634
       ln_x2 |  -.0566634   .0593114    -0.96   0.339    -.1729116    .0595848
       ln_x8 |   -.013931   .5797968    -0.02   0.981    -1.150312     1.12245
       _cons |   2.538552   .5997311     4.23   0.000     1.363101    3.714003
-------------+----------------------------------------------------------------
     sigma_u |  .55992532
     sigma_e |  .22693839
         rho |  .85890801   (fraction of variance due to u_i)
------------------------------------------------------------------------------

.
```

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```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0263                         Obs per group: min =         7
       between = 0.9841                                        avg =       7.0
       overall = 0.5863                                        max =         7

                                                Wald chi2(2)       =     35.43
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |   .0945018   .0513808     1.84   0.066    -.0062026    .1952063
       ln_x2 |  -.2399134    .079248    -3.03   0.002    -.3952366   -.0845902
       _cons |   1.643913   .2179276     7.54   0.000     1.216783    2.071043
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .24020496
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0564                         Obs per group: min =         7
       between = 0.9973                                        avg =       7.0
       overall = 0.6074                                        max =         7

                                                Wald chi2(3)       =     37.14
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x6 |   1.594519   1.076342     1.48   0.138    -.5150728     3.70411
       ln_x7 |   1.492971   .4149301     3.60   0.000     .6797232    2.306219
       ln_x5 |   .2901163   .6302591     0.46   0.645    -.9451688    1.525401
       _cons |   4.564014   .9307549     4.90   0.000     2.739768     6.38826
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .23268989
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```


```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0564                         Obs per group: min =         7
       between = 0.9973                                        avg =       7.0
       overall = 0.6074                                        max =         7

                                                Wald chi2(3)       =     37.14
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x6 |   1.594519   1.076342     1.48   0.138    -.5150728     3.70411
       ln_x7 |   1.492971   .4149301     3.60   0.000     .6797232    2.306219
       ln_x5 |   .2901163   .6302591     0.46   0.645    -.9451688    1.525401
       _cons |   4.564014   .9307549     4.90   0.000     2.739768     6.38826
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .23268989
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```


```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0564                         Obs per group: min =         7
       between = 0.9999                                        avg =       7.0
       overall = 0.6233                                        max =         7

                                                Wald chi2(3)       =     39.71
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ln_x12 |   1.753496   .8039756     2.18   0.029      .177733    3.329259
      ln_x11 |  -1.508662   .4474184    -3.37   0.001    -2.385586   -.6317379
       ln_x5 |   1.576611   .3265996     4.83   0.000     .9364877    2.216735
       _cons |   .9641206   .3493373     2.76   0.006     .2794321    1.648809
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .23268989
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

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```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.1080                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.6470                                        max =         7

                                                Wald chi2(4)       =     42.15
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x4 |   1.361387   .4040767     3.37   0.001     .5694116    2.153363
       ln_x9 |  -3.159381   1.892897    -1.67   0.095     -6.86939    .5506286
      ln_x11 |   6.556098   2.159896     3.04   0.002      2.32278    10.78942
      ln_x12 |  -12.94371   4.438151    -2.92   0.004    -21.64233   -4.245099
       _cons |  -.3838532   2.435787    -0.16   0.875    -5.157908    4.390201
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .22622908
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Countries ire Grave Dans Les Pays De l'Afrique Subsaharien

```
Random-effects GLS regression                   Number of obs      =        90
Group variable: p                               Number of groups   =        14

R-sq:  within  = 0.0066                         Obs per group: min =         1
       between = 0.1977                                        avg =       6.4
       overall = 0.1899                                        max =         7

                                                Wald chi2(3)       =      0.24
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.9716

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |  -.0070444   .0272701    -0.26   0.796    -.0604928    .0464039
       ln_x2 |  -.0225404   .0688993    -0.33   0.744    -.1575806    .1124998
       ln_x8 |   .2264216   1.017836     0.22   0.824    -1.768501    2.221344
       _cons |   2.943651   1.118178     2.63   0.008     .7520619     5.13524
-------------+----------------------------------------------------------------
     sigma_u |  .63191014
     sigma_e |  .22439546
         rho |  .88802005   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
Random-effects GLS regression                   Number of obs      =        84
Group variable: p                               Number of groups   =        13

R-sq:  within  = 0.0002                         Obs per group: min =         1
       between = 0.1800                                        avg =       6.5
       overall = 0.2548                                        max =         7

                                                Wald chi2(3)       =      2.18
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.5354

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x5 |  -.2733377   10.73726    -0.03   0.980    -21.31798    20.77131
       ln_x6 |  -1.533352   1.338974    -1.15   0.252    -4.157693     1.09099
       ln_x7 |   1.476576    1.34011     1.10   0.271    -1.149991    4.103143
       _cons |   3.400336   1.661789     2.05   0.041     .1432896    6.657381
-------------+----------------------------------------------------------------
     sigma_u |  .68108548
     sigma_e |  .22596949
         rho |  .90083846   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
Random-effects GLS regression                   Number of obs      =        98
Group variable: p                               Number of groups   =        15

R-sq:  within  = 0.4197                         Obs per group: min =         1
       between = 0.0227                                        avg =       6.5
       overall = 0.0243                                        max =         7

                                                Wald chi2(5)       =     20.97
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0008

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ln_x14 |   .0264179   .2874058     0.09   0.927     -.536887    .5897228
       ln_x9 |   .9674909   .4121623     2.35   0.019     .1596678    1.775314
      ln_x11 |   .1885693   .4222284     0.45   0.655     -.638983    1.016122
      ln_x13 |   1.204308   .5249082     2.29   0.022     .1755069    2.233109
      ln_x12 |   1.132076   .6407273     1.77   0.077    -.1237263    2.387879
       _cons |   6.174303   2.688687     2.30   0.022     .9045735    11.44403
-------------+----------------------------------------------------------------
     sigma_u |  .48022375
     sigma_e |  .17679256
         rho |  .88064476   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

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```
Random-effects GLS regression                   Number of obs      =        84
Group variable: p                               Number of groups   =        13

R-sq:  within  = 0.0002                         Obs per group: min =         1
       between = 0.1800                                        avg =       6.5
       overall = 0.2548                                        max =         7

                                                Wald chi2(3)       =      2.18
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.5354

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x5 |  -.2733377   10.73726    -0.03   0.980    -21.31798    20.77131
       ln_x6 |  -1.533352   1.338974    -1.15   0.252    -4.157693     1.09099
       ln_x7 |   1.476576    1.34011     1.10   0.271    -1.149991    4.103143
       _cons |   3.400336   1.661789     2.05   0.041     .1432896    6.657381
-------------+----------------------------------------------------------------
     sigma_u |  .68108548
     sigma_e |  .22596949
         rho |  .90083846   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```


```
Random-effects GLS regression                   Number of obs      =        84
Group variable: p                               Number of groups   =        13

R-sq:  within  = 0.0002                         Obs per group: min =         1
       between = 0.1800                                        avg =       6.5
       overall = 0.2548                                        max =         7

                                                Wald chi2(3)       =      2.18
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.5354

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x5 |  -.2733377   10.73726    -0.03   0.980    -21.31798    20.77131
       ln_x6 |  -1.533352   1.338974    -1.15   0.252    -4.157693     1.09099
       ln_x7 |   1.476576    1.34011     1.10   0.271    -1.149991    4.103143
       _cons |   3.400336   1.661789     2.05   0.041     .1432896    6.657381
-------------+----------------------------------------------------------------
     sigma_u |  .68108548
     sigma_e |  .22596949
         rho |  .90083846   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```


```
. xtreg  ln_y1 ln_x14 ln_x9 ln_x11  ln_x11  ln_x12, re
note: ln_x11 omitted because of collinearity

Random-effects GLS regression                   Number of obs      =        98
Group variable: p                               Number of groups   =        15

R-sq:  within  = 0.2946                         Obs per group: min =         1
       between = 0.0087                                        avg =       6.5
       overall = 0.0138                                        max =         7

                                                Wald chi2(4)       =     12.76
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0125

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ln_x14 |    .332352    .225547     1.47   0.141     -.109712    .7744159
       ln_x9 |   .8048642    .409077     1.97   0.049     .0030881     1.60664
      ln_x11 |   .5958113   .3540134     1.68   0.092    -.0980422    1.289665
      ln_x11 |          0  (omitted)
      ln_x12 |   .4813645   .5488549     0.88   0.380    -.5943713      1.5571
       _cons |   2.599129    1.95037     1.33   0.183    -1.223526    6.421784
-------------+----------------------------------------------------------------
     sigma_u |  .49866941
     sigma_e |   .2076954
         rho |  .85217233   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg  ln_y1 ln_x14 ln_x9 ln_x11  ln_x13  ln_x12, re

Random-effects GLS regression                   Number of obs      =        98
Group variable: p                               Number of groups   =        15

R-sq:  within  = 0.4197                         Obs per group: min =         1
       between = 0.0227                                        avg =       6.5
       overall = 0.0243                                        max =         7

                                                Wald chi2(5)       =     20.97
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0008

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ln_x14 |   .0264179   .2874058     0.09   0.927     -.536887    .5897228
       ln_x9 |   .9674909   .4121623     2.35   0.019     .1596678    1.775314
      ln_x11 |   .1885693   .4222284     0.45   0.655     -.638983    1.016122
      ln_x13 |   1.204308   .5249082     2.29   0.022     .1755069    2.233109
      ln_x12 |   1.132076   .6407273     1.77   0.077    -.1237263    2.387879
       _cons |   6.174303   2.688687     2.30   0.022     .9045735    11.44403
-------------+----------------------------------------------------------------
     sigma_u |  .48022375
     sigma_e |  .17679256
         rho |  .88064476   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

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```
Random-effects GLS regression                   Number of obs      =        10
Group variable: p                               Number of groups   =         3

R-sq:  within  = 0.0996                         Obs per group: min =         3
       between = 1.0000                                        avg =       3.3
       overall = 0.7332                                        max =         4

                                                Wald chi2(3)       =     16.49
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0009

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x4 |   3.273303   1.206395     2.71   0.007     .9088118    5.637795
      ln_x10 |  -10.47493   2.813726    -3.72   0.000    -15.98973   -4.960124
       ln_x3 |    .240339   .2950752     0.81   0.415    -.3379977    .8186758
       _cons |   2.165785     .63266     3.42   0.001     .9257946    3.405776
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .35789846
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
Random-effects GLS regression                   Number of obs      =        10
Group variable: p                               Number of groups   =         3

R-sq:  within  = 0.0996                         Obs per group: min =         3
       between = 1.0000                                        avg =       3.3
       overall = 0.7332                                        max =         4

                                                Wald chi2(3)       =     16.49
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0009

------------------------------------------------------------------------------
       ln_y1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x4 |   4.335954   1.465412     2.96   0.003     1.463799     7.20811
      ln_x15 |   10.91297   2.931391     3.72   0.000     5.167547    16.65839
       ln_x3 |    .240339   .2950752     0.81   0.415    -.3379977    .8186758
       _cons |   9.388102   2.157748     4.35   0.000     5.158995    13.61721
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .35789846
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Moderate Food Insecurity in African Countries

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```
. xtreg ln_y2  ln_x9 ln_x4  ln_x15 ln_x12 , re

Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.2108                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.8337                                        max =         7

                                                Wald chi2(4)       =    115.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x9 |  -2.338589   .9435563    -2.48   0.013    -4.187925   -.4892523
       ln_x4 |   .2616443   .0351033     7.45   0.000     .1928431    .3304455
      ln_x15 |  -.9711695   .7818117    -1.24   0.214    -2.503492    .5611533
      ln_x12 |  -3.057507   1.281442    -2.39   0.017    -5.569086   -.5459277
       _cons |  -4.107739   3.369545    -1.22   0.223    -10.71193    2.496448
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11276889
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y2  ln_x9 ln_x4  ln_x11 ln_x15 , re

Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.2108                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.8337                                        max =         7

                                                Wald chi2(4)       =    115.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x9 |  -2.338589   .9435563    -2.48   0.013    -4.187925   -.4892523
       ln_x4 |   -.380823   .2703079    -1.41   0.159    -.9106168    .1489707
      ln_x11 |  -3.497526    1.46586    -2.39   0.017    -6.370558   -.6244946
      ln_x15 |  -3.510911   1.837659    -1.91   0.056    -7.112657     .090835
       _cons |  -11.62815   6.517988    -1.78   0.074    -24.40317    1.146873
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11276889
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y2  ln_x9 ln_x4  ln_x11 ln_x13 , re

Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.2119                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.8339                                        max =         7

                                                Wald chi2(4)       =    115.48
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x9 |  -2.220602   .8805797    -2.52   0.012    -3.946506   -.4946973
       ln_x4 |   .1002927    .042537     2.36   0.018     .0169218    .1836636
      ln_x11 |  -1.203271   .2855486    -4.21   0.000    -1.762936   -.6436062
      ln_x13 |   .4669073   .2431232     1.92   0.055    -.0096053    .9434199
       _cons |  -2.228541   1.677241    -1.33   0.184    -5.515872    1.058791
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11522021
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Moderate Food Insecurity in North African Countries

```
Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.1530                         Obs per group: min =         7
       between = 0.9987                                        avg =       7.0
       overall = 0.8190                                        max =         7

                                                Wald chi2(4)       =    104.08
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x9 |  -1.268717    .608257    -2.09   0.037    -2.460879   -.0765555
       ln_x4 |   .1060359   .0457863     2.32   0.021     .0162965    .1957753
      ln_x11 |  -.6424671   .1367236    -4.70   0.000    -.9104404   -.3744938
      ln_x14 |   .3466821   .2838896     1.22   0.222    -.2097314    .9030956
       _cons |  -3.179535   3.296435    -0.96   0.335    -9.640429    3.281359
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11489488
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

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```
. xtreg ln_y2  ln_x1 ln_x2  ln_x8 , re

Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0019                         Obs per group: min =         7
       between = 0.9666                                        avg =       7.0
       overall = 0.7430                                        max =         7

                                                Wald chi2(3)       =     69.38
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |  -.0652926   .0333596    -1.96   0.050    -.1306762     .000091
       ln_x2 |  -.0821612   .0482835    -1.70   0.089    -.1767951    .0124726
       ln_x8 |   1.133203   .1835075     6.18   0.000     .7735348    1.492871
       _cons |   4.277584   .2460291    17.39   0.000     3.795376    4.759792
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .12718251
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtreg ln_y2  ln_x3 ln_x4  ln_x9 , re
note: ln_x9 omitted because of collinearity
insufficient observations
r(2001);

. xtreg ln_y2  ln_x9 ln_x4  ln_x11 ln_x12 , re

Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.2108                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.8337                                        max =         7

                                                Wald chi2(4)       =    115.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x9 |  -2.338589   .9435563    -2.48   0.013    -4.187925   -.4892523
       ln_x4 |   .5073168    .201421     2.52   0.012     .1125389    .9020947
      ln_x11 |   1.337416   1.076648     1.24   0.214    -.7727749    3.447607
      ln_x12 |  -4.226664   2.212294    -1.91   0.056    -8.562682    .1093532
       _cons |  -1.232016   1.214172    -1.01   0.310    -3.611749    1.147717
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11276889
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------


Random-effects GLS regression                   Number of obs      =        28
Group variable: p                               Number of groups   =         4

R-sq:  within  = 0.0856                         Obs per group: min =         7
       between = 1.0000                                        avg =       7.0
       overall = 0.8073                                        max =         7

                                                Wald chi2(6)       =     87.98
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x5 |   .6920994   1.227164     0.56   0.573    -1.713099    3.097298
       ln_x6 |  -14.01576    9.36704    -1.50   0.135    -32.37482    4.343302
       ln_x7 |   1.543115   .5119541     3.01   0.003     .5397032    2.546527
      ln_x13 |   2.735791   2.243038     1.22   0.223    -1.660483    7.132064
      ln_x14 |   .0671387   .3626898     0.19   0.853    -.6437201    .7779976
      ln_x15 |  -7.128004   4.325092    -1.65   0.099    -15.60503     1.34902
       _cons |  -11.42832   10.52975    -1.09   0.278    -32.06625    9.209618
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .12702982
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Moderate Food Insecurity in Sub-Saharan African Countries

```
Random-effects GLS regression                   Number of obs      =        90
Group variable: p                               Number of groups   =        14

R-sq:  within  = 0.0111                         Obs per group: min =         1
       between = 0.0372                                        avg =       6.4
       overall = 0.0249                                        max =         7

                                                Wald chi2(3)       =      0.25
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.9694

------------------------------------------------------------------------------
       ln_y2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ln_x1 |  -.0013463     .01445    -0.09   0.926    -.0296678    .0269752
       ln_x2 |  -.0026742   .0329754    -0.08   0.935    -.0673049    .0619565
       ln_x8 |   .2150626   .4440405     0.48   0.628    -.6552407    1.085366
       _cons |    4.21517   .4861513     8.67   0.000     3.262331    5.168009
-------------+----------------------------------------------------------------
     sigma_u |  .27191915
     sigma_e |  .12007948
         rho |  .83681273   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

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```
Random-effects GLS regression                   Number of obs      =        84
Group variable: p                               Number of groups   =        13

R-sq:  within  = 0.0004                         Obs per group: min =         1
       between = 0.3617                                        avg =       6.5
       overall = 0.3379                                        max =         7

                                                Wald chi2(3)       =      6.63
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0846
```

ln_y2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln_x5	1.601669	5.912233	0.27	0.786	-9.986095	13.18943
ln_x6	-.6464813	.4524698	-1.43	0.153	-1.533306	.2403431
ln_x7	1.057979	.4531867	2.33	0.020	.1697494	1.946208
_cons	4.78102	.5675583	8.42	0.000	3.668626	5.893414
sigma_u	.22133149					
sigma_e	.12468382					
rho	.75910171	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =        98
Group variable: p                               Number of groups   =        15

R-sq:  within  = 0.5291                         Obs per group: min =         1
       between = 0.1123                                        avg =       6.5
       overall = 0.1126                                        max =         7

                                                Wald chi2(5)       =     20.63
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0010
```

ln_y2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln_x14	-.0759222	.1286918	-0.59	0.555	-.3281535	.1763091
ln_x9	.406295	.1873655	2.17	0.030	.0390653	.7735246
ln_x11	.0891151	.1723006	0.52	0.605	-.2485878	.4268181
ln_x13	.558011	.2170699	2.57	0.010	.1325619	.9834602
ln_x12	.6147768	.2608576	2.36	0.018	.1035053	1.126048
_cons	6.249002	1.186152	5.27	0.000	3.924187	8.573817
sigma_u	.15312136					
sigma_e	.07214649					
rho	.8183286	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =        10
Group variable: p                               Number of groups   =         3

R-sq:  within  = 0.1338                         Obs per group: min =         3
       between = 1.0000                                        avg =       3.3
       overall = 0.7530                                        max =         4

                                                Wald chi2(3)       =     18.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0004
```

ln_y2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln_x4	1.43085	.6231429	2.30	0.022	.2095128	2.652188
ln_x10	-5.14907	1.453382	-3.54	0.000	-7.997647	-2.300493
ln_x3	.1467042	.152416	0.96	0.336	-.1520258	.4454342
_cons	3.567784	.3267897	10.92	0.000	2.927288	4.20828
sigma_u	0					
sigma_e	.18486634					
rho	0	(fraction of variance due to u_i)				

```
Random-effects GLS regression                   Number of obs      =        10
Group variable: p                               Number of groups   =         3

R-sq:  within  = 0.1338                         Obs per group: min =         3
       between = 1.0000                                        avg =       3.3
       overall = 0.7530                                        max =         4

                                                Wald chi2(3)       =     18.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0004
```

ln_y2	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ln_x4	1.953209	.7569338	2.58	0.010	.4696459	3.436772
ln_x15	5.364395	1.51416	3.54	0.000	2.396696	8.332093
ln_x3	.1467042	.152416	0.96	0.336	-.1520258	.4454342
_cons	7.117996	1.114548	6.39	0.000	4.933523	9.30247
sigma_u	0					
sigma_e	.18486634					
rho	0	(fraction of variance due to u_i)				