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An Overview of the Problem and Some Recommendations for Developing Composite Indicators Using Principal Components Analysis Regarding Food Security in Arab and African Nations

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Abstract

Considering the present state of affairs in Arab and African nations, this study examines how food security might be improved. Food security has shifted in recent years from an emphasis on food energy supply to one that encompasses a broader range of factors. This movement is briefly discussed below. In addition, recent increases in food costs are discussed in terms of their most plausible sources. Rural poverty and the failure of some developing countries to achieve successful agricultural development are often discussed in conjunction with questions of food security, as these countries often have to overcome severe restrictions on the availability of land and water resources for food production. There are numerous food security-related indicators that can be summarised by using multivariate statistical tools. A practical example of the use of Principal Components Analysis (PCA) for data concerning 52 African and Middle Eastern countries is provided, with a dataset that originally contained 13 variables. Non-mathematical explanations of PCA's stages and how they apply to this example are provided. The 'human development' and 'being at danger of hunger' dimensions are chosen as the basis for two fundamental composite indicators, or 'principal components,' and nations in the sample are ranked according to their position on these dimensions.

Key words : security of food supply, agricultural growth in Arab nations, and PCA.

Introduction.

This study focuses on the issue of food security in the developing world, which still affects a significant portion of the population. When it comes to feeding the world's growing population, the public's attention has been mostly focused on the human capacity to expand food availability, rather than on the social and economic factors that limit access to proper nourishment for the world's poorest citizens. Food insecurity is becoming a more well-understood phenomena, and the connection between it and disparities in wealth and gender have been consistently emphasised. Agricultural development's ability to both create employment in rural regions and boost food supply in food-importing nations has also been extensively acknowledged. Principal Components Analysis (PCA), a multivariate statistical gadget, has been proposed as a valuable tool for summarising several faces of a complicated subject in a few dimensions. This work intends to illustrate the essential elements of contemporary global food security difficulties.

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The possibility for agricultural output to rise until 2050 has several fundamental findings obtained (Bruinsma, 2009):

❖ In spite of population declines, agricultural productivity has increased.

❖ to meet a 40 percent growth in the world's population and bring the average food intake to 3130 calories per day/person by 2050, • would need to increase by 70 percent. Eighty percent of the increase in crop output was due to a ninety percent increase in crop productivity.

❖ Increased agricultural yields and crop intensity would account for the majority of the increase, with land expansion accounting for the balance. In industrialised economies, the amount of land needed for agricultural purposes is expected to decrease. It is expected that crop yields would rise, albeit at a slower pace than in the

❖ past, from 1.7 percent per year to 0.8 percent each year.

❖ .Overall, it seems that the world's resources will enough to feed an expanding population during the next half-century.

Tables 1 and 2 show how agricultural output has grown over the last 50 years, as well as how it is expected to develop in the next 50 years. The reduction in anticipated output growth may be seen to parallel the slowing of population increase. Agricultural yield gains have a key strategic role in ensuring continued expansion in crop output, a function that is likely to be even more critical than in the recent past. The capacity of 10 failing nations to bridge the gap with top performers, or at least to minimise distances, is more important than the ability of high-yield countries to raise the ceilings achieved at research stations in terms of yield improvements. There are now just half the yields produced by the best performers in the world's leading wheat, rice, and maize producers. If some of the gap cannot be exploited due to country-specific agro-environmental constraints, there is still potential to bridge the surmountable portion of it by using new technologies and techniques. Farmers have a history of swiftly adopting production-enhancing technology when scarcities arise and prices rise. If the social and institutional context, such as in impoverished nations, hinders this reaction, then this general

remark must be tempered. Supportive policies are needed to assist farmers in these nations overcome challenges such as a lack of access to capital and markets, a lack of educational skills, or a lack of R&D investments that are tailored to their unique requirements.

Table 1: Increases in agricultural production. past and future

	1961/63	2005/07	2050	1961/63 to 2005/07	2005/07 to 2050
	million tonnes / persons			increment in percent	
World (146 countries)					
population#	3133	6372	8796	103	38
total production*				148	70
crop production*				157	66
cereals**	843	2012	3009	139	49
livestock production*				136	76
meat production	94	249	461	165	85
(93) Developing countries					
population#	2139	5037	7433	135	48
total production*				255	97
crop production*				242	87
cereals**	353	1113	1797	215	61
livestock production*				284	117
meat production	42	141	328	236	132
(53) Developed countries					
population#	994	1335	1362	34	2
total production*				63	23
crop production*				64	30
cereals**	490	900	1212	84	35
livestock production*				62	17
meat production	52	108	133	108	23

2005/07 = 2005; 2050 from the UN 2002 Assessment; the 2050 projection from the UN 2008 Assessment amounts to 9056 million for the 146 countries covered. * in value terms. ** including rice in milled form. The latest data show a world cereal production of 2138 million tons for 2006/08 implying an increment to 2050 of less than 900 million ton if measured from the 2006/08 average.

Therefore, food insecurity that still affects a significant portion of the global population is not the result of a fundamental failure in total food supply per capita. The difficulty is that a large section of the world's population is still living in extreme poverty and lacks the buying power to buy food. People in rural areas are disproportionately affected by poverty due to a lack of agricultural development, which can be traced to a lack or inability to use proven methods, such as organic farming methods, as well as social and political unrest and a lack of access to necessary infrastructure, such as roads, bridges, and other transportation options.

Table 2: Sources of growth in crop production (percent)

	Arable land expansion		Increases in cropping intensity		Yield increases	
	1961-2005	2005/07-2050	1961-2005	2005/07-2050	1961-2005	2005/07-2050
All developing countries	23	21	8	8	70	71
sub-Saharan Africa	31	25	31	6	38	69
Near East/North Africa	17	-7	22	17	62	90
Latin America and Caribbean	40	30	7	18	53	52
South Asia	6	5	12	8	82	87
East Asia	28	2	-6	12	77	86
World	14	9	9	14	77	77
developing countries with less then 40 percent of their potentially arable land in use in 2005*		30		15		55
developing countries with over 80 percent of their potentially arable land in use in 2005**		2		9		89

Some persistent obstacles in alleviating food insecurity exist in many of the nations that suffer most from food insecurity, if one abandons the global view on possible imbalances between population and food. Massive food imports aren't a practical solution for certain impoverished nations since they lack exportable natural resources and consequently can't create the much-required foreign cash needed to fill the nutritional gap. By improving local agricultural output, these nations may address this 12 issue and improve the nutrition of their citizens while also creating employment and reducing their dependence on food imports. As a result of this, it is imperative to increase agricultural yields, especially in areas like sub-Saharan Africa, where they are presently extremely low. In many developing nations, national averages of food consumption might misrepresent the reality for huge portions of the population. Food insecurity may be hidden by national averages if income distribution is very unequal. The calculation of food deficits must precisely represent the population's segmentation in terms of food demands and the severity of nutritional gaps suffered by various socioeconomic groupings (Hoddinott, 2002).

Global Issue.

Undernourishment prevalence varies widely throughout major regions of the globe. Sub-Saharan Africa is home to the most dire circumstances and the smallest amount of advancement relative to its overall population. As seen in Tables 3 and 4, the number of persons who are undernourished as a percentage of the total population is shown in Table 4. Despite the fact that the majority of the world's malnourished population resides in Asia and the Pacific, Africa, namely Central Africa, has the highest incidence rate. Despite the fact that millions of people in Asia continue to face food insecurity, the region has

made significant improvement over the last two decades, when compared to the present scenario. Sub-Saharan Africa, on the other hand, has seen an increase in the number of people who are food insecure.

Despite this, there is a vast diversity of national circumstances to be found across the world. Using statistics from 2005-2007, FAO (2010a) reports that the percentage of people who are hungry has been reduced in half in countries like Congo, Ghana, Mali, and Nigeria, and Ethiopia is on track to do the same, according to FAO (2010a). In contrast, the percentage of hungry people in the Democratic Republic of the Congo has risen from 26% in 1990-92 to 69% now. Since the 1990-92 beginning point, China and Brazil have both made significant improvement, while India has lately witnessed a decline in the proportion of undernourished persons in the population. It was 20 percent in 1990-92, but 21 percent in 2005-07 13 in India. Even though it is still far short of the Millennium Development Goals, Bangladesh has made progress, dropping from 38% in 1990-92 to 27% in 2005-07. Over the same time period, Pakistan's population at danger of malnutrition has remained stable at roughly 25%, whereas Indonesia's population at risk has decreased from 16% to 13%. First Millennium goals are still a long way off for both nations.

Table 3. Undernourishment

Number of undernourished persons (millions)				
Country groups	1990-1992	1995-1997	2000-2002	2005-2007
WORLD	843.4	787.5	833.0	847.5
Developed countries	16.7	19.4	17.0	12.3
Developing World	826.6	768.1	816.0	835.2
Asia and the Pacific 1/	587.9	498.1	531.8	554.5
East Asia	215.6	149.8	142.2	139.5
Southeast Asia	105.4	85.7	88.9	76.1
South Asia	255.4	252.8	287.5	331.1
Central Asia	4.2	4.9	10.1	6.0
Western Asia	6.7	4.3	2.3	1.1
Latin America and the Caribbean	54.3	53.3	50.7	47.1
North and Central America	9.4	10.4	9.5	9.7
The Caribbean	7.6	8.8	7.3	8.1
South America	37.3	34.1	33.8	29.2
Near East and North Africa	19.6	29.5	31.8	32.4
Near East	14.6	24.1	26.2	26.3
North Africa	5.0	5.4	5.6	6.1
Sub-Saharan Africa	164.9	187.2	201.7	201.2
Central Africa	20.4	37.2	47.0	51.8
East Africa	76.2	84.7	85.6	86.9
Southern Africa	30.6	33.3	35.3	33.9
West Africa	37.6	32.0	33.7	28.5

1/ incl. Oceania

Table 4. Undernourishment

Prevalence of undernourishment in total population (%)				
Country groups	1990-1992	1995-1997	2000-2002	2005-2007
WORLD	16	14	14	13
Developed countries	–	–	–	–
Developing World	20	17	17	16
Asia and the Pacific 1/	20	16	16	16
East Asia	18	12	10	10
Southeast Asia	24	18	17	14
South Asia	22	20	21	22
Central Asia	8	9	18	10
Western Asia	41	27	15	7
Latin America and the Caribbean	12	11	10	8
North and Central America	8	8	7	7
The Caribbean	26	28	22	24
South America	12	10	10	8
Near East and North Africa	6	8	8	7
Near East	7	11	10	9
North Africa	–	–	–	–
Sub-Saharan Africa	34	33	31	28
Central Africa	32	49	55	53
East Africa	45	44	39	34
Southern Africa	43	41	38	33
West Africa	20	15	14	10

There has been little progress in food security for the emerging economies of the globe in the first decade of the 21st century. There have been two major crises during this time period: the food price crisis from 2006 to 2008 and the global financial and economic crisis that began in 2008. Our understanding of the repercussions for food-insecure individuals must take into account both of these factors. International agricultural prices started to climb in mid-2006 after a period of low and steady pricing and reached historically high levels in mid-2008. While corn prices jumped by a factor of five in May 2008 from their low 2002 values, corn prices soared by a factor of three in June 2008. Farmers responded to high prices by producing record harvests in the 2008 and 2009 crop years, but food commodity prices have remained volatile, and the prices of some commodities that are inputs for agriculture, like energy and fertilisers, have also 15 displayed a significant amount of volatility. 15 16 17 Prices for wheat and maize have risen by more than 50% in the last year, according to the FAO, and the outlook for global wheat output in 2011 is murky.

Food insecurity and rural poverty.

Most individuals agree that poverty is the most important factor contributing to food insecurity. In order to acquire a better understanding of the causes of food insecurity at the family level, it is necessary to concentrate on poverty and its determinants. The vast majority of the world's poor reside in developing economies, with three-quarters of the population residing in rural regions. Because agriculture is the primary source of income for the vast majority of rural residents in developing nations, a thriving agricultural sector may be an essential component of any plan to alleviate poverty and improve living circumstances for the majority of the population. The high contribution of agriculture in the labour force and the GDP of impoverished nations shows that robust growth in the agricultural sector is crucial in the early phases of the development process to stimulate global economic growth. It is later shown that when income per capita increases, agricultural production drops and other economic sectors take their place. This explains why poverty persists in rural areas even when non-agricultural production expands at an accelerated pace during the critical start-up period. The employment share of agriculture is larger than the GDP share.

The context: Africa's agricultural development

Towards the end of this article, a composite indicator for agricultural development and food security in the Mediterranean Partner Countries will be constructed utilising as a reference the situation in Africa. This section examines the current state of agricultural development in Africa, as well as the key trends and difficulties. There will be a lot of discussion on Africa's sub-Saharan region, which has historically served as a counter-example to global advancements in agricultural modernization and food nutritional quality. Only 10% of the world's population currently lives in Sub-Saharan Africa, but 30% of the world's impoverished do. More than one in two Africans live in poverty, spending less than $1 a day on necessities, a figure that is double the global average. Africa's trailing position in the fight against poverty and hunger is a direct result of the continent's uneven and sluggish economic progress. For 45 years, starting in 1960, African income per capita increased at a pace that was one-fifth of the average growth rate in other emerging nations, i.e., 0.5 percent against 2.5 percent. While per capita income in Africa and East Asia were identical in 1960, by 2003 the GDP per capita of East Asia was five times greater than that of Africa.

By the end of the 20th century, African income per capita was less than a fifth of that of the East Asian and Pacific area, which had more than doubled in purchasing power parity (PPP) adjusted terms (Ndulu et al. 2007). There is a wide range of national conditions in sub-Saharan Africa, from middle-income and relatively sophisticated countries like South Africa to failed states like

Somalia, and from large oil-rich countries like Nigeria to small and resource-poor countries like Niger, and from land-locked to coastal economies that are better connected with external markets..

The Arab nations' food security predicament.

International organisations that deal with food security sometimes refer to the Middle East and North Africa (MENA) area as a whole, even though the Sustainmed Project focuses on a smaller portion of what they term "Arab nations" or "Middle East and North Africa countries" (MENA). As a point of comparison, I'll use this vast area. Net food imports constitute for 25 to 50 per cent of total national consumption in the MENA area, making it the world's most food-dependent region. This outcome was influenced by a variety of circumstances. As a result of rising average incomes and the resulting increase in the population, demand for goods and services has altered dramatically in the previous several decades. Consider that the population of the Middle East and North Africa region has grown from 100 million in 1960 to over 300 million in 2006. As far as natural resources are concerned, the area has a limited amount of cultivable land and water. Because domestic supply cannot keep pace with expanding domestic demand, food trade imbalances have increased. Food security, on the other hand, should not be mistaken with self-sufficiency, as is widely known. However, only nations that can create enough foreign currency to pay for their imports will be able to use food trade deficits as a viable strategy for ensuring food supplies are always available. Importing food at a low proportion of overall exports is what it really implies in reality. It is true, however, that MENA countries are currently using 11.5 percent of their total exports to pay for their food imports, which is higher than the world average, and only three out of sixteen MENA countries outperform the world average in this food security indicator: Kuwait, the UAE, and Iran (Breisinger et al., 2010). Additionally, the region's reliance on oil exports exposes it to food security issues because to swings in the price of oil. Algeria, Iraq, Libya, Sudan, Syria, and Yemen stand out in this regard.

investigating the feasibility of developing an African and Middle Eastern food security composite index

Indicator of Global Hunger

A country's food security position is influenced by a wide range of issues, and international organisations, funders and academic scholars usually need to prioritise and draw worldwide comparisons. This paper describes that various attempts have been made to create composite indicators, able to sum up a wide range of partial indicators connected to food security. 45 The International Food Policy Research Institute (IFPRI) is presently producing the World Hunger Index (GHI) to quantify and monitor global hunger.

Using three equally weighted indicators, the GHI is calculated

As a percentage of the population, the percentage of people who are undernourished, which represents the percentage of people who consume inadequate nutritional energy. Undernutrition is not only caused by a lack of food intake, but also by a person's body's inability to properly use the nutrients they do get.

Underweight in children under the age of five is an indicator of how many children are underweight in relation to their age-appropriate weight.

An hazardous environment and poor dietary intake are linked to an increased death risk in children under the age of five. Nutrient deficiency in children may lead to a wide range of health problems, including poor physical and cognitive development and even mortality. According to the GHI, nations are ranked on a scale of 100 points. Values less than 5.0 indicate mild hunger, values between 5.0 and 9.9 indicate moderate hunger, values between 10.0 and 19,9 suggest a major hunger issue, and values between 20.0 and 29.9 are deemed frightening.

Global Hunger Index Scores by country, 1990 GHI and 2010 GHI

Country	1990	2010
Algeria	6.1	<5
Egypt	7.0	<5
Jordan	<5	<5
Lebanon	<5	<5
Lybia	<5	<5
Mauritania	22.0	13.1
Morocco		
Syrian Arab. Republic	7.3	5.2
Tunisia	5.0	<5
Turkey	6.0	<5
Sierra Leone	32.7	28.9
Ethiopia	43.7	29.8
Chad	37.6	30.9
Eritrea	-	35.7
Burundi	31.8	38.3
Rep. Dem. Of Congo	24.7	41.0

Source:IFPRI (2010)

Comparing some of the GHI ratings for nations in North Africa and the Middle East in 2010 with the worst six countries on the global list. On this score, it is clear that the condition of nations in North Africa and the Middle East is far better than the position of countries in Africa that suffer the most from food insecurity. Between 1990 and 2010, the Mediterranean Partner Countries made significant strides. In 2010, all except Morocco and Syria featured in the category of nations with low hunger levels, with the exception of the latter. As shown in Table 14, GHI ratings were constructed using disaggregated data from 1990 and 2010. Since 1988-92, underweight children under five years of age have climbed to 9.9 percent of Moroccan infants, the highest rate among MPC countries. Tunisia, on the other hand, has the lowest rate.

Data underlying the calculation of the 1990 and 2010 Global Hunger Indexes

Country	Proportion of undernourished in the population (%)		Prevalence of underweight in children under five years (%)		Under-five mortality rate (%)		GHI	
	1990-92	2004-06	1988-92	2003-08	1990	2008	1990 (with data from1988-92)	2010 (with data 2003-08)
Algeria	4.0*	3.0*	8.0	3.0	6.4	4.1	6.1	<5
Egypt	3.0*	3.0*	9.1	6.8	9.0	2.3	7.0	<5
Jordan	3.0*	3.0*	4.8*	3.5*	3.8	2.0	<5	<5
Lebanon	3.0*	2.0*	4.6*	4.2	4.0	1.3	<5	<5
Libya	1.0	2.0*	4.1*	5.6	3.8	1.7	<5	<5
Mauritania	10.0	8.0	43.2	19.4*	12.9	11.8	22.0	13.1
Morocco	5.0	4.0*	8.1	9.9	8.8	3.6	7.3	5.8
Syrian Arab. Republic	4.0*	4.0*	14.2*	10.0	3.7	1.6	7.3	5.2
Tunisia	1.0*	1.0*	9.1	3.3	5.0	2.1	5.0	<5
Turkey	1.0*	2.0*	8.6*	2.6	8.4	2.2	6.0	<5
Sierra Leone	45.0	46.0	25.4	21.3	27.8	19.4	32.7	28.9
Ethiopia	71.0	44.0	39.2	34.6	21.0	10.9	43.7	29.8
Chad	59.0	38.0	33.8*	33.9	20.1	20.9	37.6	30.9
Eritrea	-	66.0	-*	35.3*	15.0	5.8	-	35.7
Burundi	44.0	63.0	32.4*	35.0	18.9	16.8	31.8	38.3
Rep. Dem. Of Congo	29.0	75.0	25.2*	28.2	19.9	19.9	24.7	41.0

Note: * indicates authors' estimates. Sourde: IFPRI 2010.

The GHI allows for a richer understanding of the multifaceted food security issue than a mere headcount of people suffering from hunger, or recording the proportion of the undernourished in the total population, but it still leaves out many explanatory factors. Food insecurity is a complex phenomenon, encompassing elements related to standards of living, health, income distribution, and other aspects, and analysts must commonly deal with a vast mass of information. In this last section of the paper a multivariate analysis is proposed in order to summarise in a small number of composite indicators an array of data concerned with specific social and economic aspects related to food insecurity. Applying this methodology, it is possible to obtain scores that permit ranking individual countries according to the seriousness of the risk of suffering from hunger that their populations have to face.

Discovering aggregate dimensions of the food security problem by using Principal Components Analysis.

Principal Components Analysis (PCA) is a statistical technique, belonging to the field of multivariate analysis, which is particularly suitable in summarising the impact of a set of interconnected variables, as occur in the problem at hand. The main task of PCA in our case is to achieve data reduction, creating a small set of variables that can replace the larger original set of variables, while preserving the core of the relevant information contained in them. PCA identifies new variables, called 'components' or 'factors'2 , which are linear combinations of the original variables. The objective of the analysis is to select the minimum number of factors needed to account for the maximum portion of the total variance3 represented in the original set of variables, and then being able to assign a reasonable practical meaning to each factor. After doing that, and taking into account the specific influence of each original variable on each factor ('factor loadings') it is possible to ascertain the 'factor scores' corresponding to each observation. Observations are countries in our case, and we are constrained to take into accountthat their number must be kept in proportion with the number of the original variables included in the analysis. According to PCA, the first factor extracted may be viewed as the particular linear combination of the original variables that accounts for most of the variance in the data as a whole, than any other of all possible combinations.

The second factor represents the second best linear combination of the variables, in the sense that it accounts for most of the variance that is left unexplained after the effect of the first factor has been removed from the data. A basic restriction for the extraction of this second factor is that it must be orthogonal to the first factor, meaning that the two should not 'share' any amount of the variance of the original set of variables. A mathematical interpretation of being orthogonal is that if factors are represented by geometrical axes, each axis is at a right angle to the others. After the extraction of the first and second factors, the extraction process proceeds and new factors are extracted until all of the variance is extracted. A number of n factors can be extracted if the original set of variables contains

n variables. But, of course, it makes no sense to replace old n variables for new n variables if we are aiming for data reduction, and therefore different criteria are available for the selection of a sub-set of factors.

Conclusions

Food security is still an issue of paramount importance for many developing countries. While, in the past, this topic was predominantly analysed under the perspective of there being an adequate availability of food to cover the average needs of caloric intake, a more multifaceted approach is now commonly adopted. Not only availability, or other supply indicators, is taken under consideration, but access to food, and also stability in preserving this access, have entered the current definition of food security. Access represents the demand side of the problem of food security, and has to do with the effective endowment of economic rights which people can use to buy food. Plenty of supplies are not enough to warrant food security if people at risk lack the purchasing power to buy the food they need. A wide variety of factors may influence access, including income distribution and gender issues. Attention has also been paid to the ability of people to put their available food to good use, an important matter which is strongly linked to the quality of the social and institutional environment and personal and public health issues. Food production per capita has increased enormously over the last fifty years, driven mainly by farming intensification and the use of new, more productive, crop varieties. These developments have recurrently disproved old Malthusian-style prophecies concerning mounting risks of global disequilibrium between food resources and population.

References

[1] Abbot,P. (2009) "Development Dimensions of High Food Prices" OECD Food, Agriculture and Fisheries Working Papers, No.18, OECD Publishing, doi: 10.1787/222521043712.

[2] Baum,M. (2004) "Agriculture and biotechnology in MENA" Paper presented at the Regional Workshop on Biotechnology in the Middle East and North Africa. September 29-30 Cairo (Egypt).

[3] Barrett, Ch.B. (2010) "Measuring Food Insecurity" Science 327, pp.825-828.

[4] Benson, T., Minot,N., Pender,J., Robles,M., von Braun,J. (2008) "Global Food Crises. Monitoring and assessing Impact to Inform Policy Responses" Food Policy Report, International Food Policy Research Institute (Washington, D.C.).

[5] Binswanger-Mkhize,H.P. (2009) "Challenges and opportunities for African agriculture and food security: high food prices, climate change, population growth, and HIV and AIDS" Expert Meeting on How to feed the World in 2050. Food and Agriculture Organization of the United Nations. Economic and Social Development Department.24- 26 June 2009.

[6] Boserup,E. (1965) Conditions of agricultural growth: The economics of agrarian change under population pressure. Aldine Publishing (New York).

[7] Breisinger,C., van Rheenen,T., Ringler,C., Nin,A., Minot,N., Aragon,C., Bingxin,Y., Ecker,O., Tingju,Z. (2010). "Food Security and Economic Development in the Middle East and North Africa. Current State and Future Perspectives" IFPRI Discussion Paper 00985. May 2010. International Food Policy Research Institute.

[8] Bruinsma,J. (2009) "The resource outlook to 2050. By how much do land, water and crop yields need to increase by 2050?" Paper presented at the FAO Expert Meeting , 24-26 June 2009, Rome, on "How to Feed the World in 2050".

[9] Diao,X., Hazell,P., Resnick D., Thurlow,J. (2006) "The role of agriculture in development: Implications for Sub-Saharan Africa" DSG Discussion Paper 29. International Food Policy Research Institute (Washington D.C.).

[10] FAO (2008) The State of Food Insecurity in the World, FAO, Rome (Italy). FAO (2010a) The State of Food Insecurity in the World, FAO (Rome, Italy).

[11] FAO (2010b) "Impacts of the financial crisis on agricultural commodity markets" Committee on Commodity Problems, Sixty-eight Session, Rome 14-16 June 2010.

[12] FAO (2010c) "Management of wide international commodity price movements. National and international experiences and policy responses" Committee on Commodity Problems, Sixty-eight Session, Rome 14-16 June 2010.

[13] Hair,J.F., Black,W.C., Babin,B.J., Anderson,R.E., Tatham,R.L. (2006) Multivariate Data Analysis (6th Edition). Prentice Hall (Upper Saddle River, New Jersey, USA).

[14] Hoddinott,J. (2002) "Targeting : Principles and policy" en J.Hoddinott (Editor) Food Security in Practice.

[15] International Food Policy Research Institute. International Food Policy Research Institute (2010) 2010 Global Hunger Index. The Challenge of Hunger: Focus on the Crisis of Child Undernutrition. IFPRI (Washington DC, USA).

[16] Krueger, Anne O., Maurice Schiff and Alberto Valdés (1991), The Political Economy of Agricultural Pricing Policy, Volume 1: Latin America, Volume 2: Asia, and Volume 3: Africa and the Mediterranean, Baltimore: Johns Hopkins University Press for the World Bank.

[17] Nardo,M., Saisana,M., Saltelli,A., Tarantola,S., Hoffman,A., Giovannini,E.(2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. Joint Research Center, OECD, Paris.

[18] Ndulu, B., Chakraborti, L., Lijane, L., Ramachandran,V., Wolgin,J. (2007) Challenges of African Growth. Opportunities, Constraints and Strategic Directions. The World Bank. Washington D.C. (USA).

[19] OECD (2008b) Biofuel Support Policies: An Economic assessment. Organisation for Economic Cooperation and Development.

 [20] Plucknett,D.L. (1995) "Prospects of meeting future needs through new technology" en N.Islam (Editor) Population and Food in the Early Twenty-First Century : Meeting Future Food Demand of an Increasing Population. International Food Policy Research Institute.