FOOD SECURITY IN SUB-SAHARAN AFRICA : EVIDENCE FROM THE "UNION ECONOMIQUE ET MONÉTAIRE OUEST-AFRICAINE (UEMOA)"

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In Sub-Saharan Africa food security will remain a major issue as cereals production is decreasing and their import prices are increasing. If food security involves food availability, accessibility, stability and the utilization of food in a nutritious manner by households, it is important to examine food production stability and consumption diversification as important determinants of food security. This paper examines these relationships in the UEMOA countries. The results indicate relatively stable food productions and weak consumption diversification. As a result the food security levels in the union are overall moderate or low. Thus agricultural policies should focus on existing and potential opportunities that enhance food production and consumption diversification and competitiveness in the Union.

1. INTRODUCTION

Food security will continue to remain a major issue in Sub-Saharan Africa as food per capita is decreasing and the natural resource base is degrading (Koffi-Tessio, 1995).

Between 1960 and 1990, the agricultural production in Sub-Sahara increased only by 2% per year: agricultural exports shrank whereas food imports increased about 7% per year. It was expected that in the nineties food production increased at an annual rate of 4% and the production of export crops increased also by 4% per year. This implied that the long-term target rate of agricultural growth must be set at 4% (World Bank, 1989).

Moreover the food availability expressed in daily calories intake per capita in Sub-Saharan Africa indicated downward trends between 1961-1992 whereas the other developing regions food availability (Asia and the Pacific, Northern Africa and Near-East and Latin America and Caribbean Countries) improved (Table 1). Currently almost 800 millions of people suffer from acute malnutrition i.e. 1/5 of the population do not have adequate daily food diet in developing nations. In Sub-Saharan Africa, 2/5 of the people do not meet the food requirements (FAO, 1996).

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Table 1: Food availability per capita (1979-1992)

		1979 to 1981	1982 to 1984	1984 to 1986	1986 to 1988	Average (1979 to 1988)	1990 to 1992
Calories per day	UEMOA	2209,7	2283,6				
	DC	2324	2412	2443	2442	2405	2500
	World	2590	2647	2675	2677	2647	2710
Proteins (GR)	UEMOA	58,2	59,7				
	DC	56,4	58,4	59,5	59,8	58,6	-
	World	67,8	68,9	70,0	70,4	69,3	-

Source: *FAO Food Balance Sheet, 1992.*

Recently the World Food Security Committee indicated that World cereals production in 1995 would reach 1891 millions tons i.e. 3% or 58 millions tons less than that of 1994, 1993 and 1992. Moreover the cereals export prices are increasing (between 30% and 50%). This situation is likely to increase the food deficit in Sub-Saharan Africa and to cost 3 billions of dollars for 1995/1996.

The nature of hunger, malnutrition and food insecurity in developing countries is multidimensional (technical, socio-economic, political, cultural, etc.) but solution options proposed were too simplistic partial or inadequate, (Ghersi & Martin, 1988).

Food security defined as access of all people at all times to enough food for a healthy and active life, prevails in regions where all households can obtain sufficient and adequate food through any combination of own production and purchases at markets. Access of consumers to food depends on their income generating activities, which enable them to purchase food. Satisfactory food security at household level would imply, among other factors, stability in quantity and quality supplied as well as price of food throughout the year, given the seasonality in local production.

If food security involves at least food availability, accessibility, stability and the utilization of food in a nutritious manner by households, it is important to examine food production stability and consumption diversification as important determinants of food security.

The major hypothesis is that countries that stabilize and diversify both their food production and consumption are likely to ensure greatly food security than those that do not.

This paper examines the relationships between food security and diversification of food production and consumption in the UEMOA countries. First the institutional setting of the UEMOA will be summarized. Second a theoretical discussion between food security, production and consumption diversification will be presented. Third the degree of production, consumption and food security situation is assessed. Finally the food policy implications are highlighted.

2. THE INSTITUTIONAL SETTING : THE WEST AFRICAN ECONOMIC AND MONETARY UNION (UEMOA)

The UEMOA is a regional economic and monetary integration (REMI) that comprises Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. The seven countries signed the treaty on the 10th of January 1994 in Dakar. The objective is to promote free movement of goods and services, people and capitals with the ultimate aim at establishing a West African market.

There are three leading organs of the REMI: The Heads of States Conference, the supreme organ, the Cabinet and the Commission. The Conference sets the main guidelines of the UEMOA, the Cabinet is responsible for the policies implementation and the Commission, a body representing seven commissioners, in each country, prepares the projects to be submitted to the Cabinet and for the approval by the Conference. The Commission also prepares the budget for its adoption and implementation.

The financial resources of the union will be secured through levies on Common External Tariff (TEC) and internal taxes of members states. However between August 1994-1997 the financial resources of the institution had being secured at 90 % by the West African Central Bank (BCEAO) and the West African Development Bank (BOAD).

3. THE THEORETICAL FRAMEWORK : FOOD SECURITY, PRODUCTION AND CONSUMPTION DIVERSIFICATION

In microeconomic theory, a risk-averse farmer will in general reduce risk and uncertainty in order to secure food for three related reasons:

- to reduce the variability of income over time. In such case farmer can plan his debt payment, family living expenses and farm growth;

- to ensure some minimum income level to meet family living expenses and other fixed expenses;
- to avoid business failure. In such a case, farmers would be willing to accept a lower expected income if it reduces income variability and hence the risk of business failure (Kay, 1986).

There exist different methods for reducing risk and uncertainly associated with variable income. Some tend to reduce overall variability and others to ensure a minimum price or income.

Production risk is caused by variability of crop and livestock yields, the price received and the resulting net income. Among the techniques used for reducing production risk the most relevant for farmers in developing countries is diversification.

In agricultural production, diversification by producing two or more commodities may reduce income variability if all prices and yields are not low or high at the same time.

It is usually demonstrated that crop specialisation may lead to the following results:

- provide the greatest average income but yield the greatest variability;
- reduce income variability but also the average income.

In this case the remaining option is to diversify. This is likely to reduce variability and to stabilize average income. The negative correlation between the incomes received for the two crops tend to smooth out income under diversification and reduce income variability.

In actual farm situation, the extent of reduction of income variability through diversification depends on the price and yield correlation for the enterprises selected. If both prices and yields for the enterprises tend to move up and down together, little is gained by diversifying. The more these values tend to move in opposite direction, diversifying will reduce the more income variability. In these respects weather is the primary factor influencing crop yields. Crops with different growing season experience and susceptible to different insects and diseases are likely to be less positively correlated.

The positive yield and price correlation between many agricultural commodities implies that diversification will be less.

It is important to indicate that diversification may mean giving up specializing in a highly profitable but also highly variable enterprise to gain the benefits from less variability in net income.

In recent developments, there are three approaches for incorporating risk in agricultural programming models (Anderson, Dillon & Hardaker, 1977 and Anderson & Dillon, 1992).

- the mean-variance approach
- the game theory approach
- the risk constraint approach of which the well known is the Minimization of Total Absolute Deviation (MOTAD) developed by Hazell (1971). An improved version of this model involves the estimation of risk aversion coefficient that is incorporated in the objective function (Elamin & Rogers, 1996).

Within a macroeconomic framework, market food equilibrium equation (Malassis & Pradilla, 1986) can be defined as:

$$Q = \frac{N\,W\,\beta}{Pa} \qquad (1)$$

Where:

Q = the effective quantities of food purchased at that price
Pa = the general level of food price (the average price of a calorie or the weighted average prices of all food items purchased)
N = the working population
W = the average wage
β = the average propensity to consume food items

It is obvious that the market food equilibrium equation (1) may not be consistent with food equilibrium.

Given the size of the population (H), the average social level of consumption (Q/H) can be compared with any of the three nutritious levels defined previously. Suppose that the recommended nutritious level by nutritionists (Bc) is concerned, any of the three situations may occur:

a) $\frac{N W \beta}{Pa}$ = Q > H Bc, then the society is achieving its marked food equilibrium at a level higher than the recommended nutritious levels (desirable state).

b) $\frac{NW\beta}{Pa}$ = Q < H Bc, then the society is achieving its marked food equilibrium at a level lower than the recommended nutritious levels (undesirable state).

c) $\frac{NW\beta}{Pa}$ = Q = H Bc, the society is achieving its market food equilibrium at the recommended nutritious level (acceptable state)

In the latter case it can easily be demonstrated that in the case of specialisation;

where Q = Q1 an $\beta = \beta 1 > 0$ and the case of diversification where Q = Q1 + Q2 + ... Qn with $\beta = \beta 1 + \beta 2 \ldots \beta n$ and $\beta 1\ \beta 2 \ldots \beta n > 0$ the society will be achieving its market food equilibrium at the recommended nutritious requirements at higher level in the case of diversification than in the case of specialization, i.e.:

$$\frac{N W (\beta_1 + \beta_2 + \ldots \beta_n)}{Pa} = Q_1 + Q_2 + \ldots Q_n = HB_{CD} > \frac{N W \beta_1}{Pa} = Q_1 = HB_{CS}$$

Where HB_{CD} = nutritional defined in the case of diversification and HBCS the same level defined in the case of specification.

At the macroeconomic level, it may be implied that a rational country will attempt to reduce production and consumption uncertainties through diversification in order to sustain food security for its citizens. As such food security at all times at a country level would imply, among other factors, stability in quantity and quality supplied as well as in food prices.

This study uses the mean-variance approach in order to assess the extent of stability of major food production, the food balance sheet to assess the consumption diversification and the household food security global index (HFSGI) to measure food security levels.

It is hypothesized that countries that register greater production and consumption diversification and stability are likely to achieve greater food security than others.

4. DATA SOURCES

The study uses times series aggregate food production and consumption data for the UEMOA countries between 1984 and 1994. Both data were collected from FAO yearbook and FAO Food Balance Sheets.

Production data include the major food crops such as maize, rice, millet, sorghum, cassava, yams and livestock products such as poultry, beef and small ruminants meats. These data are summarized in Table 2 and 3.

Due to lack of time series aggregate consumption data, food balance data were collected and used as proxies of consumption.

Finally, the data on food security calculated in terms of calories per capita per day are extracted from a recent FAO publication.

5. EMPIRICAL FINDINGS

5.1 Degree of stability of food production in the UEMOA countries

Between 1984 and 1994, the food production stability in the UEMOA countries is assessed on the basis of their coefficient of variation (CV) and average coefficient of variation (ACV). The higher is their value, the lower is their stability.

As such the food in the UEMOA is classified into four categories on the basis of probability distribution:

- countries productions with CV and ACV between O and 25 are considered very stable ;
- countries productions with CV and ACV between 26 and 50 are considered relatively stable ;
- countries productions with CV and ACV between 51 and 75 are considered relatively unstable ;
- countries productions with CV and ACV between 76 and 100 are considered very unstable.

With respect to food crops production in Benin, maize, rice, cassava and yams productions are stable whereas its millet and sorghum productions are

Table 2: Mean (X), Standard of deviation (σ) and coefficient of variation (CV) and average coefficient of variation (ACV) of selected food crops production in the UEMOA countries, 1984-1994 (1.000 MT)

	MAIZE			RICE			MILLET			SORGHUM			CASSAVA			YAMS			
	X	σ	CV	X	σ	CV	X	σ	CV	X	σ	CV	X	σ	CV	X	σ	CV	ACV
Benin	427,64	71,88	16,8	9,82	1,60	16,2	20,64	5,70	27,6	95,82	28,28	29,5	876,64	183,95	20,9	998,90	190,14	19,0	21,66
Burkina Faso	244,64	117,44	48,0	44,36	14,50	32,6	672	153,37	22,8	997	228,03	22,8	17,63	13,60	77,1	50,54	18,63	36,8	40,01
Côte d'Ivoire	483,09	43,51	9,0	620,45	71,00	11,4	49,27	16,40	33,2	25,09	3,56	14,1	1413,81	117,50	8,3	2806,45	420,81	14,9	15,15
Mali	207	73,03	35,2	313,81	129,00	111,1	881,18	223,94	25,4	707,87	115,58	16,3	68,82	15,22	22,1	11,27	3,90	34,6	29,11
Niger	8,81	2,71	30,7	67,73	8,74	12,9	1437,18	354,17	24,6	433,36	205,07	47,3	207,81	15,8	7,60	—	—	—	24,62
Senegal	117,91	14,03	11,8	157,18	17	10,8	604,18	143,21	23,7	112,87	20,72	18,3	39,82	25,61	64,3	—	—	—	25,78
Togo	244	70,50	28,8	26,27	7,32	27,8	83,63	39,40	47,1	121,45	19,66	16,1	429,08	45,76	10,6	391,72	50,66	12,9	23,88

Source: FAO Yearbook (1984-1994) and author's calculation, 1996.

Table 3: Mean (X), standard of deviation (σ), coefficient of variation (CV) and average coefficient of variation (ACV) in the UEMOA countries 1984-1994 (1000 MT)

	POULTRY MEATS			GOATS AND SHEEP MEATS			BEFF MEATS			ACV
	X	σ	CV	X	σ	CV	X	σ	CV	
Benin	28,27	3,66	12,9	6,18	0,40	6,4	14,27	1,42	9,9	9,73
Burkina Faso	22,09	1,84	8,3	20,90	8,47	10,5	31,36	6,43	20,5	13,1
Côte d'Ivoire	36,81	9,62	26,1	11	2	18,1	38,45	4,29	11,1	18,43
Mali	17,45	6,97	39,9	43,45	4,88	11,2	66,36	14,03	21,1	24,06
Niger	19,36	3,10	16,0	41,27	6,42	15,5	36,09	1,44	3,99	11,83
Senegal	19,27	2,86	04,8	20,72	6,00	28,9	43,81	2,14	4,8	12,83
Togo	8,18	7,06	86,3	5,54	1,43	25,8	4,81	0,40	8,3	40,13

Source: FAO year book and author's calculation, 1984-1994

relatively stable on the basis of the CV during the periods 1984-1994. Consequently the overall food crop production in Benin is classified as very stable on the basis of its ACV.

In Burkina Faso cassava production is very unstable whereas its maize, rice and yams productions are relatively stable on the basis of the CV. However its overall food production is relatively stable on the basis of its ACV.

In Côte d'Ivoire and Togo, all the productions are either stable or relatively stable on the basis of the CV. But the overall food crops production in both countries is very stable on the basis of the ACV.

In Mali and Niger, the same results are obtained on the basis of the CV and the overall food crops production is considered as relatively stable on the basis of the ACV.

Finally, in Senegal, except for cassava's production that is considered relatively unstable, the other productions are very stable.

The above results are summarized in Table 2.

With respect to livestock production, poultry, goats/sheep and beef meats production in Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger and Senegal are

either stable or relatively stable except for Togo is poultry production which is very unstable on the basis of the CV.

Overall the livestock production is very stable in all countries except for Togo where overall livestock production is relatively stable. The results are summarized in Table 3.

ACV obtained in Table 2 and 3 enable us to assess the overall stability of food production in the UEMOA. Food production in all UEMOA countries is either stable or relatively stable. None is classified as having unstable food production. The results are summarized below in Table 4.

Table 4: Overall Average Coefficient of Variation (OACV) of food production in the UEMOA countries

	ACV Crop production	ACV livestock production	OACV	Assessment
Bénin	21,66	9,73	15,69	Very stable
Burkina Faso	40,61	13,10	26,55	Relatively stable
Côte d'Ivoire	15,15	18,43	16,79	Very stable
Mali	29,11	24,06	26,58	Relatively stable
Niger	24,62	11,83	18,22	Very stable
Sénégal	25,78	12,83	19,30	Very stable
Togo	23,88	40,19	32,00	Relatively stable

Source: FAO Food Production Year book; (1984-1994) and author's calculation, 1996

5.2 Food consumption diversification : the food balance sheet

The FAO balance sheet is a comprehensive indicator of the pattern of country's food supply during a given period. For each commodity potentially available for human consumption, it indicates the origin of the supply and its utilization. The food supply for a given period is represented by the total country's food production plus total quantity of food imports adjusted to stocks variation. The food utilization takes only into account the quantity of food available for human consumption. Due to lack of effective disaggregated consumption data, the food available for human consumption is divided by the appropriate population size to obtain the per capita food supply and is used as a proxy of effective disaggragate consumption. Based on food composition factors, all the

food items were converted to caloric value and protein and fat content. The data are summarized in Table 5.

These data display the following characteristics in the UEMOA countries:

- the food diet is made of vegetable and animal products which indicates some apparent degree of food consumption diversification though the vegetable production contribution is greater than that of animal production in all the UEMOA countries ;

- consequently vegetable products provide more caloric value, proteins and fats than animal products in all the UEMOA countries. This is as true in the coastal countries (Benin, Côte d'Ivoire, Senegal and Togo) as in the sahelian states (Burkina Faso, Mali and Niger);

- except for Benin in 1984-1986, the protein content in the food diet is overall greater than the fats content in all the UEMOA countries ;

- between 1984-1988, the caloric value in the Sahelian countries increased whereas it decreased in the coastal countries ;

- except in Togo where there was a slight decrease in the protein content, the overall trend of protein content in the UEMOA countries increased. This is a good indicator of the improved nutrition in the UEMOA countries.

5.3 Food security in the UEMOA countries : The Household Food Security Global Index (HFSGI)

The HFSGI an extension of the Global Indicator of Poverty (Poverty Global Indicator) proposed by Sen (1976) is developed by FAO. It measures the extent of malnutrition in developing countries. The HFSGI is defined as follows:

$$HFSGI = 100 - [H \{G + (1 - G) I^P\} + 0{,}5\ \Omega \{1 - H[G + (1 - G) I^P] 100$$

Where

H = the percentage of malnutritious people
G = food deficit
IP = indicator of unequal food deficit distribution
Ω = coefficient of variation of caloric food availabilities, the probability of temporary food insecurity

Table 5: Per caput food supply (1984-1988)

	Benin		Burkina Faso		Côte d'Ivoire		Mali		Niger		Senegal		Togo	
	1984-86	1986-88	1984-86	1986-88	1984-86	1986-88	1984-86	1986-88	1984-86	1986-88	1984-86	1986-88	1984-86	1986-88
CALORIE PER DAY														
Grand total	2175	2157	1878	2037	2506	2448	2018	2147	2330	2373	2338	2205	2223	2148
Vegetable products	2074	2056	1779	2353	2353	2291	1875	2005	2162	2211	2134	1979	2132	2058
Animal products	101	100	100	153	153	158	143	142	168	162	203	226	91	91
PROTEIN (GRAMS PER DAY)														
Grand total	48,7	50,00	58,6	63,8	53,1	52,2	58,8	61,6	66,8	68,7	69,7	70,7	51,8	50,9
Vegetable products	39,6	40,8	51,4	56,3	40,1	38,8	46,5	49,4	54,5	56,8	51,0	50,3	43,4	42,5
Animal products	9,1	9,2	7,2	7,5	13,0	13,4	12,3	12,2	12,3	11,9	18,7	20,4	8,3	8,5
FAT (GRAIMS PER DAY)														
Grand total	51,2	49,7	39,6	45,0	46,6	47,5	33,8	36,9	39,6	38,0	54,1	44,9	34,6	33,9
Vegetable products	44,9	43,5	33,5	38,7	38,4	39,0	25,2	28,3	28,6	27,3	43,1	32,2	29,0	28,3
Animal products	6,4	6,2	6,1	6,3	8,2	8,5	8,6	8,6	11,1	10,7	11,1	12,7	5,6	5,6

Source : FAO Food Balance Sheets, 1991

The index synthesized the three components of food security : food availability, stability and accessibility.

The index varies from O (complete hunger) to 100 (complete food security) based on FAO arbitrary classification, countries with HFSGI greater and equal to 85 have high security levels ; countries with HFSGI between 75 and 85 have average food security levels, countries with HFSGI between 65 and 75 have low food security levels.

The HFSGI of all the UEMOA countries are summarized in table 6.

Table 6: The household Food Security Global Index (HFSGI) for the UEMOA countries 1988-1996

	1988-1990	1991-1993	1993	Level of food Security
Benin	76,9	77,5	75,7	Remained average
Burkina Faso	68,00	79,1	73,9	Improved from low to average
Côte d'Ivoire	82,6	77,0	71,8	Remained average
Mali	70,4	75,8	73,2	Improved from low to average
Niger	71,3	83,4	75,7	Improved from low to average
Senegal	74,4	68,0	69,7	Remained low
Togo	73,2	69,8	72,5	Remained low

Source: FAO CFS, (1994) 94(2):37-38.

The above HFSGI display the following characteristics:

- none of the 7 UEMOA countries has a high food security level i.e. a HFSGI equal or greater than 85 ;

- the food security situation is overall stable in all the coastal countries. In Benin and Côte d'Ivoire the level of food security remained average whereas it remained low in Senegal and Togo between 1988-1993. On the contrary, the food security situation improved from low levels to average levels in all the Sahelian countries (Burkina Faso, Mali and Niger).

6. CONCLUSION : LESSONS FROM THE UEMOA COUNTRIES AND FOOD POLICY IMPLICATIONS

Food production in all the UEMOA countries is found to be either stable of relatively stable (Table 2 and 3) and their food consumption weakly diversified. The latter implies that the degree of diversification is biased toward vegetable production in all the UEMOA countries.

In fact in all the UEMOA countries, vegetable production is greater than animal production though the former provides more caloric value, proteins and fats than the latter. Overall, the protein content is greater than the fats content and its trend is positive between 1984-1988. This indicates the continuous effort of these countries to increase the nutritious level of their population. As such countries with low HFSGI such as Senegal and Togo in 1993 have recorded either a decrease of their caloric value or a stable protein and fats content in their diet between 1984-1988. Countries which HFSGI remained average in 1993 such as Benin and Côte d'Ivoire recorded an increase or a stable protein content between 1984-1988. Finally countries such as Burkina Faso, Mali and Niger whose HFSGI improved from low to average between 1988-1993 have recorded an increase of their diet protein contents between 1984-1988 (Table 7).

Table 7: Summary of result on production, consumption diversification and food security

	Production Stability	Consumption Diversification	Food Security Level
Benin	Very stable	Weak*	Remained average
Burkina Faso	Relatively stable	Weak	Improved to low to average
Côte d'Ivoire	Very stable	Weak	Remained average
Mali	Relatively stable	Weak	Improved to low to average
Niger	Very stable	Weak	Improved to low to average
Senegal	Very stable	Weak	Remained low
Togo	Relatively stable	Weak	Remained low

* Weak = in all the countries food consumption is diversified but strongly based toward vegetable production.

Source *:* Tables 2, 3, 4, 5 & 6 established by the author, 1996.

Consequently countries which attempt to have a stable or relatively stable food production and diversify to some extent their food consumption achieve either a stable food security (Benin, Côte d'Ivoire) or a greater food security (Burkina Faso, Mali, Niger). However Senegal and Togo with a stable or relatively stable food production and with a weak consumption diversification record, achieve low food security levels. This result could be explained in Togo by the degradation of purchasing power of the population since 1990.

It is clear from the above that the UEMOA with 60 million people and 3.5 million square kilometers, to become a dynamic and effective agricultural integration scheme in the future, should reformulate its agricultural policies in order to maintain a higher stable competitive and diversified production that will enable it to move from the weak to a strong consumption diversification position. Countries with comparative advantage should seize the opportunities to produce cheaper food items for the union's population without penalising the farmers. This is also likely to guarantee a stable purchasing power for the population and enhance food security levels with the UEMOA. However, the agricultural competitiveness of the UEMOA will depend on the stability of FCFA vis-à-vis the dollar.

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