Food Security Index For Economic Community of West-African States (ECOWAS)

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Abstract

Purpose: *In this article attempt is made to develop a composite food security index for some selected countries of the Economic Community of West-African States (ECOWAS), e.g. Nigeria, Niger, Benin, and Ghana. The study also aims to study the stability property of the indicators of composite food security index.*

Approach/ Methodology/ Design: *For constructing a composite food security index for ECOWAS, one can use the basic methodology already developed by IFAD but in a modified form. This study is also based on IFAD methodology but with one more additional variable that is political stability index and assigned weight on the basis of Principal Component Analysis (PCA).*

Findings: *This composite index is an improvement over all the other food security index developed by others eminent economists and institutions from time to time. This index consists of six indicators such as food availability, food production, self-sufficiency of food, inverse relative price index, child survival index, and political stability to construct the composite food security index of ECOWAS. Political stability is an additional indicator in the index of ECOWAS. With the help of this index, the trends, stability and situation of food security index in region are discussed and analyzed from 2001 to 2018.After careful analysis of composite food security index of ECOWAS, one can find out that It has quite impressive and improving gradually.*

Practical Implication: *This study provides strong suggestion about how these five indicators of composite food security index provide an overview for the selected countries to secure their level of food security in their respective country.*

Originality/Value: *After the careful analysis of the collected data, it can be concluded that the composite food security index plays an important role to understand whether food security index is improving in respective countries or not.*

1. Introduction

Hunger is rising continuously world-wide, and the absolute number of undernourished people, *i.e.* those facing chronic food deprivation, has increased to nearly 821 million in 2017 from around 804 million in 2016 (FAO, 2018). The situation is worsening in South America and most of the regions of Africa (Table 1). Africa remains the continent with the highest Prevalence of Undernourishment (PoU), affecting almost 21 percent of the population (more than 256 million people) (FAO, 2017). The situation is also deteriorating in South America, where the PoU has increased from 4.7 percent in 2014 to a projected 5.0 percent in 2017. Asia's decreasing trend in undernourishment seems to be slowing down significantly. The projected PoU for Asia in 2017 is 11.4 percent, which represents more than 515 million people (FAO, 2018). Without increased

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efforts, the world will fall far short of achieving the SDG target of eradicating hunger by 2030.

The Economic Community of West African States (ECOWAS) is a regional group of 15 countries like other group of countries. It was founded in 1975 and its objective is to promote economic integration in "all fields of economic activity, particularly industry, transport, telecommunications, energy, agriculture, natural resources, commerce, monetary and financial questions, social and cultural matters. West Africa has become the fastest-growing region of the African continent, with economic growth rate of 6.7 percent in 2013 and 7.4 percent forecast for 2014 (African Economic Outlook, 2013).Though the oil and other minerals are playing a vital role in economic growth of the ECOWAS but most of the population's livelihoods of this region depends on agriculture activities and this sector is still the major source of food, income and livelihood of the ECOWAS population. However, the food production of this region is unable to meet the growing demand of the community. Therefore, the region needs to import about the 20 percent of the food consumed (OECD/SWAC, 2013) to meet the growing demand for more foods.

In this region, the prevalence of hunger and malnutrition is shared out by the Millennium Development Goals. In spite of these efforts the supply of food remains critical in absolute terms, with more than 36 million people of this region badly suffering from food grain and they remain malnourished. In 2008, due to the hike in food prices the level of food security was seriously affected across the world and in most of the developing countries where people were bound to live on less than a dollar. The main factors responsible for imbalance of food are the price hike, poor harvest of crops in the major agriculture regions, increase in demand for food in China and India, diversification of food crops from human consumption to biofuel and manufacturing animal feed were also significant factors (Iqbal &Amjad, 2009). Therefore, 44 million people were pushed to poverty (World Bank) as a result of food price hike, and thus imbalance between demand of food and supply was created. Apart from the food supply imbalance, the region suffers from serious climate and man-made challenges, such as droughts, floods and civil crisis. These frequently lead the region to food deficit situation and further food insecurity (FAO, 2014). Nevertheless, the region started making balance in their food supply and for this they made a strong political association among the region to reduce the dependency on food import. They started intra-regional trade of food.

One can see the prevalence of undernourishment in the world and various regions of the world in table 1 below.

Table 1: Prevalence of Undernourishment in the World, 2005–2017

Prevalence of undernourishment (%)						
	2005	2010	2012	2014	2016	2017[1]
World	14.5	11.8	11.3	10.7	10.8	10.9
Africa	**21.2**	**19.1**	**18.6**	**18.3**	**19.7**	**20.4**
Northern Africa	6.2	5.0	8.3	8.1	8.5	8.5

Sub-Saharan Africa	24.3	21.7	21.0	20.7	22.3	23.2
Eastern Africa	34.3	31.3	30.9	30.2	31.6	31.4
Middle Africa	32.4	27.8	26.0	24.2	25.7	26.1
Southern Africa	6.5	7.1	6.9	7.4	8.2	8.4
Western Africa	12.3	10.4	10.4	10.7	12.8	15.1
Asia	**17.1**	**13.6**	**12.9**	**12.0**	**11.5**	**11.4**
Central Asia	11.1	7.3	6.2	5.9	6.0	6.2
Eastern Asia	14.1	11.2	9.9	8.8	8.5	8.5
South-eastern Asia	18.1	12.3	10.6	9.7	9.9	9.8
Southern Asia	21.5	17.2	17.1	16.1	15.1	14.8
Western Asia	9.4	8.6	9.5	10.4	11.1	11.3
Central Asia and Southern Asia	21.1	16.8	16.7	15.7	14.7	14.5
Eastern Asia and South-eastern Asia	15.2	11.5	10.1	9.0	8.9	8.9
Western Asia and Northern Africa	8.0	7.1	8.9	9.3	9.9	10.0
Latin America And The Caribbean	**9.1**	**6.8**	**6.4**	**6.2**	**6.1**	**6.1**
Caribbean	23.4	19.8	19.3	18.5	17.1	16.5
Latin America	8.1	5.9	5.4	5.3	5.3	5.4
Central America	8.4	7.2	7.2	6.8	6.3	6.2
South America	7.9	5.3	4.7	4.7	4.9	5.0
Oceania	**5.5**	**5.2**	**5.4**	**5.3**	**5.3**	**5.4**
Northern America And Europe	**<2.5**	**<2.5**	**<2.5**	**<2.5**	**<2.5**	**<2.5**

[1] *Projected Value*

Source: Food Agriculture Organization, 2017

The purpose of this paper is to develop a composite food security index to measure the level of food security of ECOWAS. A large number of indicators for food security have been identified by the Food and Agriculture Organization (FAO). However, no attempt has been made to combine these indicators to develop and construct a composite food security index for measuring food security level of ECOWAS. However, the International Fund for Agriculture and Development (IFAD) has constructed a food security index for measuring food security of 114 countries using the following indicators (Khan, 2013):

- Per capita daily calorie supply
- Annual growth rate of per capita daily energy supply
- Food production index
- Self-sufficiency ratio
- Production variability
- Consumption variability

For constructing a composite food security index for ECOWAS, the basic methodology already developed by IFAD is usually used but in a modified form. On the basis of IFAD methodology, others like M. Iqbal and R. Amzad (2009) and Pakistan Task Force on Food Security also

constructed food security index for SAARC countries and Pakistan as well, taking into account only four indicators like food availability index, food production index, self-sufficiency ratio index and inverse relative price index and they took weighted mean of the indicators giving arbitrary weights to the said four indicators. They assigned ½ weight to each one and for this there is no sufficient reason to why these weights are being assigned to these indicators. In addition, Khan B. has also constructed a composite food security index for India using one additional indicator; that is, child survival rate index indicators. He also employed the Principal Components Analysis (PCA) to assign the appropriate weights to all five indicators.

This study is also based on IFAD Methodology but with one more additional variable; political stability index and assigned weight on the basis of Principal Component Analysis (PCA). The reason for including political stability index is that it is an important indicator concerning food security in ECOWAS region. If the political environment is stable, then the policy for the alleviation of poverty, unemployment, food security will be implemented properly. It may also give more positive results.

There are several other indicators that also affect food security of a country or of a region but in this article, due to lack of data, it is limited only up to six indicators which emphasize production, availability, self-sufficiency ratio, inverse related price ratio, child survival rate index, and political stability index.

2. Methodology and Procedures

In this study, two hypotheses are formulated as below:

> **RH1:** Composite Food Security Index for ECOWAS has been stable since 2001.
> **RH2:** The individual indices of food security, e.g., production of food, availability of food, inverse relative price index, self-sufficiency ratio index, child survival ratio index and political stability index have been stable since 2001.

For calculating Composite Food Security Index for some selected countries of ECOWAS, first we took the indicators—per capita food production index, per capita food availability index, self-sufficiency ration index, inverse relative price index, child survival rate index, and political stability index. Out of six indices, four have been calculated, e.g., per capita food availability index, self-sufficiency ration index, inverse relative price index, child survival rate index and two have been taken from Food Agriculture Organization (FAOSTAT, 2019) and multiply with their Eigen values for the assigning of appropriate weight to both of them and after that their base years have been converted into 2001 so that one can easily compare whether the all indices or composite indices are improving or not. The other four indices, i.e. FAI, SSRI, IRFPI and CSRI, have been calculated on the basis of below formula and multiplied by their Eigen values for assigning the appropriate weight to them.

$$FAI = \frac{\text{Total Food Production}}{\text{Total Population}} * 100, \qquad \text{Where FAI=Food Availability Index,}$$

$$SSRI = \frac{\text{Total Output}}{\text{Total Output} - \text{Export} + \text{Import}} * 100, \qquad \text{Where, SSRI= Self-Sufficiency Ratio Index,}$$

$$IRFPI = \frac{\text{Consumer Price index}}{\text{Food Price Index}} * 100, \qquad \text{Where, IRFPI= Inverse Relative Food Price Index,}$$

$$CSRI = \frac{1000 - UFMR}{1000} * 100, \qquad \text{Where, CSRI= Child Survival Ratio Index.}$$

For assigning weights to different indices, Principal Component Analysis (PCA) has been used (Khan, 2013). By means of rotated factor loading (pattern matrix), the following results were obtained. Values for the four ECOWAS countries are based on the robust Eigen values and in the table below only the highest values are presented.

Table 2: Principal Component Analysis (PCA) Results

Variable	Nigeria (Eigen Value)	Niger (Eigen Value)	Benin (Eigen Value)	Ghana (Eigen Value)
FAI	4.172	3.79	3.54	3.83
FPI	0.961	0.98	1.05	1.10
SSRI	0.675	0.77	0.776	0.91
IRPS	0.107	0.36	0.308	0.90
CMRI	0.056	0.046	0.305	0.051
PSI	0.030	0.04	0.497	0.008

Source: Author's Calculations.

Table 2 shows factor loadings for all the four countries for giving weights to different indicators which are extracted by PCA; one can give weights to food production index, self-sufficiency ratio index, inverse relative price index, child survival rate index, and political stability ratio index. For constructing all six indices, the year 2001 can be used a base year for all four ECOWAS countries so that one can easily understand how per capita availability of food, per capita food production, inverse relative price index, child survival rate index, and political stability index are stable. With the help of these six indicators, one can calculate a composite food security index for Economic Community of West African States (ECOWAS) and further assume 2001 as a base year for it.

$$CFSI = FPI. X_1 + FAI.X_2 + IRPI.X_3 + SSRI.X_4 + CSRI.X_5 + PSI.X_6$$

Where, $X_1, X_2, X_3, X_4, X_4, X_6$ are representing Eigen value.

3. Results and Discussion

The researcher calculated a composite food security index for some selected countries of ECOWAS with 2001 as a base year. The results indicate that food security index for Nigeria, Niger, Benin, and Ghana is gradually improving. For Nigeria in 2001, it was 100 that is base

year, and in 2015 it was the highest 214.24 (table 3, appendix). While in Niger in 2007, it was the highest, i.e., 185.33. After that, it started declining but it was always more than the base year. The situation of composite food security index in Benin is also impressive; it was the highest in 2016 reaching 191.92. In Ghana, the status of food security index also improved better than the base year 2001. It was the highest in 2018 recording 165.15.

For checking stability of composite food security index of ECOWAS, the researcher applied Chow Test and calculated 'F' ratio and found that the index was stable in all four selected countries of ECOWAS since 2001. In this way the second research hypothesis has been satisfied. Similarly, stability for availability index, production index, self-sufficiency ratio index, inverse relative price index, child survival rate index, and political stability index have been tested, and it is found out that food production, food availability, child survival index and political stability index for Nigeria has been stable. However, self-sufficiency ratio and inverse relative price index is highly unstable (table 3, appendix).

While in Niger, food production, food availability and child survival were found stable, but self-sufficiency ratio, inverse relative price index, and political stability index has been found highly unstable (table 4, appendix). In Benin, food production and child survival are found stable, but other four variables have been unstable. Moreover, among the four, political stability has been highly unstable (table 5, appendix). Food production, food availability, child survival, and inverse relative price index have been found stable in Ghana, while self-sufficiency ratio and political stability were found unstable (table 6, appendix).

Therefore, it is concluded that some of the variables have been found stable in these four countries of ECOWAS and some are not found stable. Nevertheless, out of the four variables, political stability has been found highly unstable in Niger and Benin. To assign the appropriate weight for all the six indices, a Principal Component Analysis (PCA) technique was used; however, it has its own limitations. It may be less efficient since it neglects some information on correlation among the indicators. Even the indicators themselves may not be independent to each other (Khan, 2013).

Finally, to solve the problem of food insecurity in these countries, the government must introduce more new income generation programs and supervise the existing one in such a way that people have sufficient income. Therefore, they may have physical and economic access to sufficient and healthy food for their healthy and active life.

4. Conclusion and Suggestion

Agricultural and allied sector have more importance in the ECOWAS region. However, its contribution to GDP is minimal. Therefore, it is the responsibility of the concerned government of these countries to diversify their economy and put more focus on agriculture and allied

activities so that the imports of food grain will be minimized and in future the region becomes self-dependent in terms of food production.

As indicated in the tables 3,4,5, and 6, the political stability is not very important for the composite food security index. It seems that it is not playing an important role in securing food security in the region. The reason behind this is that a significant amount of food grains for their consumption is imported by the ECOWAS countries. However, some of the countries of the region *e.g.* Nigeria and Ghana, are putting more focus on their agricultural activities. Nigeria in particular has started food import substitution policy, though it not fully implemented, but at least it has started.

Conflict of Interest

The authors declares no conflict of interest

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References

African Economic Outlook (2013).

Economic Community of West African States (ECOWAS) Report, 2018.

Enrique de Loma-Ossorio, Carmen Lahoz and Luis F. Portillo, (2014), "Assessment of the Right to Food in the ECOWAS region", Institute of Hunger Studies, Food and Agriculture Organization of the United Nations Rome.

Iqbal, M., & Amjad, R. (2012). Food security in South Asia: strategies and programmes for regional collaboration. In *Regional integration and economic development in South Asia*. Edward Elgar Publishing.

International Fund for Agriculture Development (IFAD), Rome, 2012.

Khan B. (2013), "A new food security index for India", Man & Development, Centre for Research in Rural and Industrial Development, Chandigarh, India, Vol. XXXV No. 3, pp. 19-30,

Food Agriculture Organization, FAOSTAT, 2017 & 2019.

UN ESA 2011, World Urbanization Prospects: The 2011 Revision. UN Dept. of Economic and Social Affairs, Population Division (available at http://esa.un.org/unpd/wup/CD-ROM/Urban-Rural-Population.htm). Accessed 16 September 2014.

OECD/SWAC, 2013.

UN ESA, (2013), "World Population Prospects: The 2012 Revision. UN Dept. of Economic and Social Affairs, Population Division. (available at http://esa.un.org/unpd/wpp/Excel-Data/population.htm), Accessed 16 September 2014.

Sanitation facilities and drinking water sources, WHO/UNICEF, 2013.

World Development Indicators, World Bank Reports, 2017.

Appendix

Table 3: Composite Food Security Index of Nigeria

Year	FPI	FAI	SSRI	IRPI	CSRI	PSI	CFSI
2001	100	100	100	100	100	100	**100.00**
2002	104.81	93.55	75.61	72.03	100.70	111.64	**115.86**
2003	109.14	96.43	89.26	71.98	101.42	111.64	**126.03**
2004	115.95	103.27	75.40	66.70	102.13	119.86	**139.43**
2005	122.28	108.19	121.54	75.87	103.35	114.38	**139.75**
2006	130.12	115.84	63.74	32.46	103.42	139.04	**178.69**
2007	121.84	105.92	63.36	16.71	104.00	137.67	**175.94**
2008	129.48	117.81	69.46	28.81	104.53	127.39	**180.37**
2009	114.55	106.12	83.19	36.07	104.98	136.98	**155.99**
2010	130.03	119.97	77.62	36.57	105.36	151.36	**176.96**
2011	122.94	127.31	110.91	23.63	105.68	134.24	**175.97**
2012	138.27	123.05	92.84	28.70	105.93	139.72	**190.35**
2013	136.41	136.95	94.17	20.24	106.16	143.15	**196.56**
2014	152.16	138.05	97.96	20.02	106.37	145.89	**214.23**
2015	154.43	139.24	77.56	27.53	106.55	132.191	**214.24**
2016	152.93	138.03	59.59	48.64	106.73	128.76	**201.72**
2017	153.48	137.18	69.09	47.43	106.95	132.87	**202.22**
2018	154.85	138.97	73.28	35.99	107.22	134.24	**210.37**

Source: Author's Calculations

Table 4: Composite Food Security Index of Niger

Year	FPI	FAI	SSRI	IRPI	CSRI	PSI	CFSI
2001	100.00	100.00	100.00	100.00	100.00	100.00	**100.00**
2002	106.98	112.42	114.34	141.04	100.10	-108.33	**114.97**
2003	103.85	105.26	120.43	160.21	100.22	33.33	**117.99**
2004	94.77	102.28	133.04	144.05	100.34	-425	**114.89**
2005	105.84	110.99	106.52	135.32	100.45	-408.33	**111.82**
2006	109.64	116.23	100	100	100.57	-191.66	**105.28**
2007	111.87	132.60	132.60	448.94	100.67	-383.33	**185.33**
2008	129.23	136.23	102.17	255.91	100.77	-558.33	**144.86**
2009	102.89	112.26	115.21	286.49	100.87	-958.33	**143.53**
2010	125.96	125.99	108.70	276.31	100.96	-966.66	**147.57**
2011	106.96	113.03	98.04	362.17	100.96	-733.33	**156.22**
2012	112.42	118.58	91.09	310.71	101.10	-958.33	**146.77**
2013	111.41	115.37	98.06	430.04	101.10	-1100	**171.18**
2014	111.99	116.70	91.08	435.68	101.20	-983.33	**171.32**
2015	114.24	118.99	98.06	356.26	101.25	-891.66	**157.75**
2016	118.06	123.89	82.78	216.17	101.29	-916.66	**128.43**
2017	121.21	122.47	97.26	212.72	101.42	-1083.33	**131.00**
2018	118.02	124.87	78.44	216.55	101.32	-1000	**127.83**

Source: Author's Calculations

Table 5: Composite Food Security Index of Benin

Year	FPI	FAI	SSRI	IRPI	CSRI	PSI	CFSI
2001	100.00	100.00	100.00	100.00	100.00	100.00	**100.00**
2002	111.68	120.48	151.61	106.18	100.122	102.5	**111.90**
2003	103.20	112.71	215.32	114.68	100.123	85	**113.87**
2004	106.98	120.12	194.35	112.50	100.123	33.75	**114.14**
2005	108.86	118.05	307.25	121.35	100.123	56.25	**125.38**
2006	99.30	102.04	630.64	57.31	100.124	68.75	**146.72**
2007	102.43	106.11	556.45	38.91	100.124	48.75	**140.84**
2008	111.29	135.34	592.74	52.77	100.124	46.25	**151.45**
2009	129.46	139.39	473.38	96.11	100.124	50	**150.03**
2010	111.13	144.71	94.35	71.21	100.124	32.5	**107.58**
2011	129.89	154.01	858.87	49.05	100.125	40	**185.08**
2012	128.58	165.17	533.06	57.74	100.125	45	**156.33**
2013	149.29	178.60	766.12	43.25	100.125	37.5	**186.73**
2014	131.73	187.62	779.83	42.01	100.125	3.75	**181.93**
2015	121.72	175.22	779.19	55.73	100.126	-1.25	**177.12**
2016	134.07	183.31	865.32	82.42	100.126	0	**191.92**
2017	134.66	181.68	853.22	85.50	100.126	6.25	**191.00**
2018	135.51	180.64	831.45	86.89	100.126	7	**189.29**

Source: Author's Calculations

Table-6: Composite Food Security Index of Ghana

Year	FPI	FAI	SSRI	IRPI	CSRI	PSI	CFSI
2001	100	100	100	100	100	100	**100**
2002	127.84	102.63	100.01	110.97	100.0003	44.44	**118.85**
2003	108.97	104.38	99.98	129.20	100.0006	-8.33	**114.41**
2004	108.97	105.26	99.97	142.77	100.0009	-11.11	**107.30**
2005	117.90	107.017	99.98	159.57	100.0011	-47.22	**113.62**
2006	114.34	108.77	99.99	222.46	100.0014	-2.77	**98.55**
2007	97.09	109.64	99.98	253.22	100.0016	19.44	**101.06**
2008	136.73	112.28	100.00	320.25	100.0019	8.33	**127.83**
2009	157.88	114.91	100.00	346.96	100.0022	-8.33	**142.38**
2010	177.67	118.42	100.00	358.06	100.0025	-8.33	**156.19**
2011	160.90	118.42	99.99	414.08	100.0029	-47.22	**145.47**
2012	175.58	118.421	100.01	415.75	100.0032	-36.11	**155.05**
2013	172.08	117.54	99.99	473.68	100.0035	-16.66	**152.79**
2014	175.54	117.54	99.99	645.53	100.0038	30.55	**155.74**
2015	176.08	116.66	99.99	766.83	100.0041	8.33	**156.36**
2016	180.55	116.66	99.99	931.92	100.0043	36.11	**159.94**
2017	182.22	118.42	99.99	865.19	100.0045	-25.00	**161.19**
2018	186.85	120.17	99.99	991.60	100.0047	-22.22	**165.15**

Source: Author's Calculations