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Emmanuel OBIANG ONDO

PRICE MOVEMENT ANALYSIS OF SELECTED AGRICULTURAL PRODUCTS IN GABON

DEPARTMENT OF AGRICULTURAL ECONOMICS

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ÖZ

YÜKSEK LİSANS TEZİ

GABON'DA SEÇİLMİŞ TARIM ÜRÜNLERİNDE FİYAT HAREKETLERİNİN ANALİZİ

Emmanuel OBIANG ONDO

ÇUKUROVA ÜNİVERSİTESİ
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Tüm gelişmekte olan ülkelerde olduğu gibi, Gabon'da da gelirden gıdaya ayrılan pay önemlidir. Gıdaya erişim birçok faktör tarafından etkilenmektedir. Başlıca faktörlerden biri de fiyat dalgalanmalarıdır. Fiyat dalgalanmaları hem tüketicileri hem de üreticileri etkilemektedir. Bu çalışmada seçilmiş on iki tarım ürününün yıllık ve aylık fiyat dalgalanmaları analiz edilmektedir. Ayrıca Gabon'da gıda fiyatları ile ilgili sorunların daha iyi ele alınabilmesi için öneriler geliştirilmektedir. Çalışmada kullanılacak ikincil veriler Gabon Kalkınma Destek Enstitüsü'nden (IGAD) sağlanmıştır. Elde edilen veriler seçilmiş on iki tarım ürününün Libreville piyasasındaki tüketici fiyatları olup 2005 ile 2015 arasındaki dönemi kapsamaktadır. Veriler SPSS ve Excel yazılımları ile analiz edilmiş, çeşitli trend modelleri yanı sıra bazı temel istatistik hesaplamalar yapılmıştır. Sonuçlar, genel olarak, Libreville piyasasında ürün fiyatlarının oldukça istikrarsız olduğunu ve amarant ile marul dışındaki ürün fiyatlarının yıldan yıla arttığını göstermektedir. Temel gıda maddeleri (manyok ve yemeklik muz) fiyatlarının diğer ürünlere göre daha olumsuz etkilendiği görülmüştür. Aylık dalgalanmalar da analiz edilmiş ve fiyatların Mayıs ile Kasım arasında daha yüksek olduğu gözlenmiştir. Çevrimsel hareketler de analiz edilmiştir. Eldeki verilerin imkân verdiği ölçüde fiyat hareketlerinin gerisindeki nedenler açıklanmıştır. Tüm bulgular, fiyatların daha yakından izlenmesi ve arzın yerel olarak arttırılması için iyi bir veri toplama ve finansman sisteminin kurulması gerektiğini göstermektedir.

Anahtar Kelimeler: Fiyat Analizi, Fiyat Hareketleri, Gabon, Tarım Ürünleri

ABSTRACT

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In Gabon, as in all developing countries, the share of income allocated to food is very important. Access to food is influenced by many factors. One of those major factors is price fluctuations. Price fluctuations affect both producers and consumers. This study aims at analyzing annual and monthly price fluctuations of selected twelve agricultural products. It also formulates some suggestions to help better deal with the problems related to food prices in Gabon. To conduct this study, secondary data were obtained from the Gabonese Institute for Development Support (IGAD). Data obtained were consumer prices of selected twelve agricultural commodities in Libreville market and covers the years of 2005-2015. Data were analyzed employing SPSS and Excel software and several trend models were developed, together with some basic statistical calculations. The results showed that in general, the product prices in Libreville market were very unstable and constantly increasing during the study period, with the exception of amaranth and lettuce. The prices of staple foods (manioc and plantain) were found to be affected more adversely than the others. Monthly fluctuations were also analyzed and prices were found higher between May and October. Cyclical movements were also analyzed. Reasons behind price movements were explained as the data in hand allowed. All the findings lead to several suggestions for establishment of a good data collection and financing system in order to monitor prices more closely, and to increase supply locally.

Key Word: Price Analysis, Price Movements, Gabon, Agricultural Products

GENİŞLETİLMİŞ ÖZET

Bir Afrika ülkesi olan Gabon'da, tıpkı diğer gelişmekte olan ülkelerde olduğu gibi, halkın gelirinin çok büyük bir bölümü gıda maddelerine ayrılmaktadır. Gelişmekte olan ülkelerde gıdaya erişim birçok faktör tarafından olumsuz bir şekilde etkilenmektedir. Son zamanlarda yağışlardaki dengesizlikler, aşırı sıcaklıklar ve kuraklıklar, taşkınlar, çeşitli doğal afetler tarımsal üretimi olumsuz yönde etkilemekte, uluslar arası piyasalarda gıda arzında düşüşlere yol açmakta ve bu da tarımsal ürün fiyatlarının artmasına neden olmaktadır. Hem yoksul hem de gıdaya erişimde uluslararası piyasalara bağımlı olan ülkeler de kuşkusuz bu durumdan daha fazla etkilenmektedirler.

Gabon yaklaşık 5 milyon ha verimli arazi sahibi bir sahra altı Afrika ülkesidir. Afrika ülkeleri arasında nüfus yoğunluğu en düşük olan ülkelerden biridir. Yaklaşık 1.8 milyon olan nüfusunun %86'sı Libreville, Port-Gentil ve bir ölçüde Franceville gibi büyük kent merkezlerinde toplanmıştır. Libreville Gabon nüfusunun neredeyse yarısının ikamet ettiği başkenttir. Araştırma alanı olarak Gabon'u temsilen Libreville kentinin seçilme nedenlerinden birisi de bu olmuştur.

Gabon ve CEMAC bölgesinin geri kalan kısmında genellikle aynı tür tarımsal ürünler tüketilmektedir. Farklılıklar bazen tarımsal ürünlerin kullanım tarzlarında, tüketim şekilleri ve gıda hazırlama süreçlerindedir. Gabon'da iklim koşulları sıklıkla birçok mahsulün üretimini etkilemektedir. Mahsul üretimini etkileyen olumsuz sebeplerden en önemlisi, tarım sektöründeki yetersiz yatırım ve yetersiz desteklerdir. Gabon, insanların tarımsal sorunlarını çözmelerine yardımcı olmak amacıyla kurulmuş, onlara gerektiğinde kredi sağlamakla yükümlü bir tarım bankasına sahip değildir. Önemli nedenlerden biri de proje oluşturma ve sürdürme konusunda karşılaşılan güçlüklerdir. Bu durumda, çiftçilerin, iklimsel olayların olumsuz etkilerini gidermeleri, en azından hafifletmeleri amacıyla uygun yatırımlar yapmaları, gerekli girdileri, makine ve aletleri satın almaları ve tarımsal faaliyetlerini uygun şekilde yürütmeleri oldukça güçtür. Tarımsal faaliyetlerde, Gabon'da çok az insanın, kendi kendilerini finanse etme ve yeni çiftlikler kurma imkânı vardır. Bunun doğrudan gözlenebilir sonucu, insanların iklimin ritmine göre elde edebildikleri ürünlerin nicelik ve niteliğidir; bu gerçek, pazarda satılan mevcut ürün kalite ve miktarlarına bakılarak doğrulanabilir.

Libreville pazarında, tarım sektörünün yapısal açıdan kusurlu olduğu ve devletin tarımsal faaliyetleri sübvanse etmediği, bu nedenle de tarımsal ürün

fiyatlarını sabitlemek ve düzenlemek için bir yasal mevzuatın bulunmadığı görülmektedir.

Gabon, tarımsal ürünler için üretim, satış ve tüketim ile ilgili göstergeleri takip eden bir yapıya sahip değildir. Gabon'da, tüm gelişmekte olan ülkelerde olduğu gibi, gıdaya tahsis edilen gelirlerin payı oldukça yüksektir. Gıdaya erişim, genellikle yiyecek fiyatlarındaki dalgalanma gibi birçok faktörden etkilenir. Yüksek Lisans tezi olarak "Gabon'da Seçilmiş Tarım Ürünlerinin Fiyat Hareketlerinin Analizi" başlıklı bu çalışmanın seçilme nedenlerinden biri de budur. Bu çalışmada, seçilmiş ürünlerin yıllık ve aylık ortalama perakende fiyatları toplanmış, uzun dönem trend analizleri, mevsimlik dalgalanmalar, konjonktürel hareketler analiz edilmiştir. Çalışma sonucunda hem ilerideki çalışmalar hem de mevcut sorunlarla ilgili öneriler geliştirilmesi amaçlanmıştır.

Analizde ikincil veriler kullanılmıştır. Bu çalışmayı yürütmek için belirlenen on iki tarım ürününün 2005-2015 yıllarını kapsayan on bir yıllık döneme ait Libreville perakende satış fiyatları, kısaca IGAD adıyla anılan Gabonese Geliştirme Destek Kurumu'ndan temin edilmiştir. IGAD, Gabon Tarım ve Hayvancılık Bakanlığı'nın bir ajansı olup ülkedeki tarımsal projelerin uygulanmasından sorumludur. IGAD, yalnızca projeler sırasında çalışan bir pazar bilgi sistemine sahiptir. Bir başka deyişle, sadece projeye yönelik veri toplamakta, proje bittiğinde veri toplama işlemine devam etmemektedir.

Sunumda kolaylık sağlamak amacıyla toplanan on iki ürün dört kategoriye ayrılarak incelenmiştir. Bu kategoriler ve kapsadığı ürünler şunlardır: Aromatik ve Yaprağı Yenen Sebzeler: Fesleğen ve Kereviz; Yaprağı Yenen Sebzeler: Amarant, Köpek Üzümü, Kıvırcık Marul, Hibiskus Çayı (Mekke Gülü, Roselle); Meyvesi Yenen Sebzeler: Acı Biber, Domates, Beyaz Patlıcan; Temel Besin Maddeleri: Yumru Manyok (Cassava), Kasava Çubukları ve Pişirmelik Muz (Plantain).

Ülke ekonomilerinde sadece tarım ürünleri fiyatları değil, bunun yanı sıra diğer mal ve hizmetlerin de fiyatları artmaktadır. Bu nedenle tarım ürünleri fiyatlarındaki artışların genel fiyat düzeyi ile karşılaştırılması gerekmektedir. Bir başka deyişle, cari fiyat artışlarının yanı sıra reel fiyat artışlarının da incelenmesi gerekmektedir. Bunun için ise tüketici fiyat endekslerine ihtiyaç duyulmaktadır. Bu çalışmada kullanılan 2010 baz yılına ait tüketici fiyat endeksi Dünya Bankası sitesinden alınmıştır ve çalışma amaçlarına uygun şekilde baz yılı dönüşümü yapılmıştır. Kentlerdeki yaşam koşulları, genel fiyat düzeyleri birbirinden oldukça farklı olduğundan Libreville kentine ait tüketici fiyat endekslerinin kullanılması

daha doğru olmasına rağmen böyle bir endeks mevcut olmadığından Gabon Tüketici Fiyat Endeksinden yararlanılmıştır.

Çalışmada ayrıca, aynı konu veya alandaki diğer çalışmalardan sağlanan veriler, resmen yayınlanmış veya yayınlanmamış diğer tezler, makaleler ve diğer eserler de kullanılmıştır.

Araştırmada kullanılan fiyatlar, değeri Avro (bir (1) Avro = 650.58 CFAF) ile sabitlenmiş olan CFA Frangı cinsinden ifade edilmiştir.

Verileri analiz etmek ve ürün fiyatları tahmininde kullanılacak eşitlikler en küçük kareler yöntemiyle elde edilmiştir. Hesaplamalarda SPSS ve Excel yazılımlarından istifade edilmiştir. Her ürün için, hem cari hem de reel fiyatlar kullanılarak doğrusal, karesel ve kübik trend modelleri oluşturulmuş, gerek istatistiksel gerek pratik seçim kriterlerinden yararlanılarak en iyi model seçilmek istenmiştir. Mevcut eğilimler sürdüğü takdirde, seçilen modeller gelecekteki fiyatların tahmin edilmesi amacıyla kullanılabilecektir. Bunun yanı sıra sabit ve değişken esaslı endeksler, aylık endeksler ve zaman serileri çevrimsel bileşen değerleri hesaplanarak yorumlanmıştır. Bulunan trend eşitliği hem mevsimlik dalgalanmalardan trend etkisinin elenmesinde hem de çevrimsel bileşenin trende oranlanarak yorumlanmasında kullanılmıştır. Gerek yıllar gerek aylar arasında fiyatlarda meydana gelen yükselme ve alçalmaların nedenleri araştırılmıştır. Bunun yanı sıra her ürün için hem sabit hem cari fiyatlarla yıllık ortalama fiyat artışları hesaplanmıştır. Bu analizlerin sonuçları Libreville pazarında satılan tarımsal ürün fiyatlarının yıllar içinde sürekli arttığını ve çok istikrarsız olduğunu göstermiştir. En önemli bulgulardan birisi de en yüksek fiyat artışlarının manyok ve pişirmelik muz gibi ürünleri kapsayan temel besin maddeleri grubunda ortaya çıktığının görülmesidir. Karabiber fiyatlarında da yıllık artışlar oldukça yüksektir. Fakat her gün herkes tarafından kullanılan ürünler olmaları, bir başka deyişle talebin yüksekliği ve talep fiyat esnekliklerinin düşük olması nedenleriyle manyok ve pişirmelik muz fiyatlarındaki yıllık artışlar gıda erişimi açısından kaygı verici artışlardır. İki üründe ise (marul ve amarant) fiyatlar sürekli olarak düşmektedir. Gabon'da IGAD ve Fransız işbirliğiyle sürdürülen bir projenin verdiği destekler nedeniyle bu ürünlerde üretim artışlarının bu durumun nedeni olabileceği düşünülmektedir. Ancak mevcut durumda eldeki verilerin yetersizliği nedeniyle bu konu ilave araştırmaları gerektirmektedir. Aylık sonuçlar ise, birçok üründe hasat ve ekim zamanlarına bağlı fiyat hareketlerini ortaya koymuştur. Mevsimlik dalgalanmalar yardımıyla yıl içerisinde fiyatların maksimum ve minimum olduğu ayları belirlemek mümkün olmuştur

Hasat ile elde edilen ürün, arzın bileşenlerinden sadece biridir. Stoklanmış ürünler, ithalat ve ihracat arzın diğer bileşenleridir. Gabon'da arz çoğu zaman talebi karşılayamamaktadır. İthalatlar da çoğu kez yetersiz kalmaktadır. Buna bağlı olarak da fiyatlar yükselmektedir. İthal fiyatları dünya çapında meydana gelen iklim değişikliklerden de etkilenmektedir. Ancak, ne yazık ki yıl bazında tarımsal ürün ithalat verilerine erişmek mümkün olmamıştır. Sorunların çözümüne katkıda bulunmak için aşağıdaki noktalar önerilir: Bu tür çalışmaların sağlıklı bir şekilde yürütülebilmesi sağlıklı verilerin bulunmasına bağlıdır. IGAD sadece proje esnasında veri toplamaktadır. Gabon nüfusunun neredeyse yarısının yoğunlaştığı Libreville kentine ait bir Tüketici Endeks Serisi mevcut değildir. Var olan ithalat verileri bölük pörçüktür. Öncelikle sağlıklı bir veri tabanının oluşturulması gerekmektedir. Bu veri tabanı teknik, ekonomik ve istatistiksel göstergelerle ilgili verileri içemeli ve araştırmacıları kullanımına sunulmalıdır. Yatırımlarla ilgili sorunların çözülmesi amacıyla bir finansman kurumu oluşturulmalıdır. Gelişmekte olan ülkeler ve özellikle Afrika ülkeleri, gıda fiyatlarındaki şoklara ve iklim değişikliğine karşı çok savunmasızdır. Gıda güvenliği ve tarımsal araştırma alanlarında çaba gösterilmelidir. Artan gıda fiyatlarının neden olduğu gıdalara sınırlı erişim sağlandığında, yoksullar için sosyal koruma girişimlerine ihtiyaç vardır. Sürdürülebilir tarımsal büyüme için sürdürülebilir yatırımlara da ihtiyaç vardır. Bunlar, kırsal altyapının ve tarımsal hizmetlerin iyileştirilmesine ve iklimsel tehlikelere karşı daha az hassas olan yeni tarımsal uygulamaların araştırılmasına yönelik yatırımlar olabilir.

Bu çalışmanın sonuçları, on iki ürünün fiyatlarında yıllar içinde keskin artışların yanı sıra yıl boyunca aylık istikrarsızlıklar olduğunu göstermiştir. Özellikle aylık sonuçlar, mayıstan ekim ayına kadar olan dönemde belirgin bir istikrarsızlık ve yükselen fiyatlarla karşılaşıldığını göstermiştir. Sonuç olarak, bu çalışma, bazı temel gıda ürünlerinin fiyatlarının Libreville pazarında nasıl değiştiğinin anlaşılmasını mümkün kılmıştır. 2005'ten 2015'e kadar, fiyat dalgalanmaları gözlenmiştir. Bu dalgalanmaların işaretlendiği yıl dönemleri ve sorunun kökleriyle ilgili bazı sebepler elde edilmiştir. Elde edilen sonuçlara göre, tarımsal faaliyetler için finansman ve izleme yapılarının yanı sıra üretim düzeyinde, bir yandan verimi öte yandan da üretim alanını artırmak için daha fazla yatırım yapılması gerektiği açıktır. Ayrıca, ithal edilen ürünlerde Gabon'daki fiyat dalgalanmaları ve tarımsal ürün fiyatlarının hızlı yükselişinden sorumlu olan dış ve iç nedenlerin belirlenmesi için daha fazla çalışma yapılması da önerilmektedir.

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LIST OF ABBREVIATIONS

AFD	: (Agence Française de Developpement) French Development Agency
CEMAC	: Community of Central African States
CFAF	: Currency used in GABON with the code XAF (1 euro = 650 CFAF)
Const.	: Constant
Corr. Mean	: Corrected Mean
Corr. Mon. Inx	: Corrected Monthly Index
Cu/E	: Current Price / Estimated Price
CV	: Coefficient of Variation
DCs	: Developing Countries
DİE	: Turkey Government Statistic Institutes
D –W	: Durbin Watson
FAO	: Food and Agriculture Organization of the United Nations
FMI	: International Monetary Fund
GDP	: Gross domestic product
ha	: Hectare
hg	: Hectogram
IFAD	: International Fund for Agricultural Development (Food and Agriculture Organization of the United Nations)
IGAD	: (Institut Gabonais d'Appui Au Developpement), Gabonese Institute for Development Support
kg	: Kilogram
MIS	: Market Information System
PRODIAG	: (Projet de Developpement et D'investissement Agricole Au Gabon), Gabon Agricultural Development and Investment Project

R^2 adj.	: R^2 adjusted
R/E	: Real Price / Estimated Price
Std. Err.	: Standard error
Total Corr	.: Total correction
WTO	: The World Trade Organization

1. INTRODUCTION

The prices of agricultural products have always been subject to fluctuations over time and between regions of the world and sometimes they take excessive dimensions, penalizing agricultural activity and food consumption. (Anonymous, 2011).

In 2007, an article titled “Economic Notes and Studies” stressed that, in today's world, agriculture remains the main sector of activity with an estimated worker of 1.3 billion (95 percent of which is in developing countries) and supports about 2.5 billion people, more than 40 percent (40%) of the world's population (Anonymous, 2007).

The information above shows the importance of agriculture for humanity, its products and all the activities attached to it. Trade in agricultural products, which is one of the activities that directly links agricultural production and consumers, turns out to be a very sensitive activity. In the conclusion of the document titled “Module de Formation à l’Analyse des Prix Agricoles”, it is said that world food trade continues to grow rapidly, but the structure and characteristics of trade differ considerably by product and region. The key driver of production and demand, including trade and related policies, shape these (Dembele et al, 2008).

In this study, which deals with the analysis of agricultural product prices in Gabon, the general characteristics of the country show that, Gabon is a country that covers 267,667 km² of area. It is located in the center of the Gulf of Guinea, crossed by Equator in Central Africa, three quarters of its territory is covered with forest, and disposes of abundant fish stocks. The resident population of Gabon in 2013 is 1,811,079 inhabitants. The population is mainly urban (86%) and concentrated on only 1.1% of the national territory. The rural environment is almost empty (rural desert). The population density at the national level is low, 6.8 inhabitants per km^2, but actually reaches records in some places. For example, it

exceeds 3,700 inhabitants per km^2 in Libreville, the capital of the country. (Anonymous, 2015a).

Gabon in the international classification is a developing country and in Table 1 below, Ntsama (2014), presents the share of food expenditure in the household budgets of some Central African countries classified as developing countries and those of the so-called developed countries. It shows that, the share of expenditure allocated to food decreases significantly with the increasing of standard of living. It is therefore less important in developed countries and very important for developing countries.

Table 1.1. Distribution of an Additional $ 1 of Income between Categories of Expenditures In 2005

Countries	Food drinks and tobacco (%)	Clothing (%)	House renting (%)	Furniture (%)	Health (%)	Transport & communication (%)	Leisure (%)	Scholar (%)	Others (%)
Cameroon	39	6	16	5	5	13	5	3	8
Central Africa	47	6	15	5	4	11	3	3	6
Chad	47	6	15	5	4	11	3	3	6
Congo Republic	44	6	16	5	4	12	4	3	6
Gabon	**32**	**5**	**17**	**6**	**7**	**14**	**7**	**3**	**10**
Equatorial Guinee	31	5	17	6	7	15	7	3	10
France	11	5	19	6	11	19	12	3	16
Germany	10	5	19	6	11	19	12	3	16
UK	9	5	19	6	11	19	12	3	16
Luxemburg	7	5	19	6	11	19	13	2	17
US	6	5	19	6	12	20	13	2	17

Source (Ntsama, 2014)

The data in this table would thus reflect the very relevant impact that a change in food prices may have in household budgets and in the lives of people in

Central African countries in general. On the same table, concerning the case of Gabon, it appears that, money spent on food consumption increases 32 cents for each additional dollar of income. In other words, the marginal propensity to consume is 32%.

In continuation, the World Bank study stressed that, since June 2010, an additional 44 million people have fallen below the poverty line ($1.25) as a result of higher food prices. Simulations show that a further 10% increase in the food price index could lead to an additional 10 million people falling into poverty, and a 30% increase could plunge 34 million people into poverty (Ebeke, 2014).

It is also apparent from Badolo's doctoral thesis that, developing countries and more particularly African countries are highly vulnerable to food price shocks and climate changes. This vulnerability is explained by the fact that these countries depend on food imports and have a climate sensitive agricultural sector (Badolo, 2013).

Concerning the statistical data of the agricultural sector of Gabon, the Gabonese economist Mays Mouissi reveals that, after 55 years of independence, agricultural production in Gabon covers less than 20% of national needs. The agricultural sector, which was still 44% of GDP in 1963 and provided food self-sufficiency to the population, represented only 3.6% of national wealth in 2014 (Mouissi, 2015).

The World Trade Organization (WTO) estimates that, 60% of the food consumed in Gabon is imported while the government mentions figures reaching 80%. Gabon spends up to 300 billion CFA francs (450 million euros) per year on food imports, which means that the country is extremely vulnerable to fluctuations in world prices and shortages of staple foods such as cereals and milk powder, (Anonymous, 2015b).

These figures confirm a very disturbing reality raised by Ebeke, when he exposes the criteria necessary to say that a country is vulnerable. Ebeke in 2014

cites in their work “Are Foreign Aid and Remittance Inflows a Hedge against Food Price Shocks?” De Janvry and Sadoulet (2008) in these terms: countries are vulnerable if they meet the following three criteria: (1) high food dependency, (2) a high food import burden and (3) low income (Ebeke, 2014).

In this citation, it is remarked that the reality of the food sector in Gabon hosts all the characteristics that expose it to the variations of product prices, it also verifies the three criteria necessary to say that a country is vulnerable.

It is also seen that, although the instability of international prices is usually much more publicized, it is the instability of food prices in developing countries (DCs) that has the most serious consequences, because it directly affects the income of producers and the purchasing power of consumers in these countries (Galtier et al, 2012).

All the facts described in this valuable information lead us to a finding that has already been stressed in other words in a study and tells us that; food prices in urban markets in sub-Saharan Africa are the main source of income for agricultural producers and determine the costs of access to food for urban households. Their fluctuations are recognized as detrimental to an optimal adjustment of supply and demand (Minkoua et al, 2010).

The results of all these studies have shown that, the food price fluctuations can be fatal for people in developing countries. Thus, even the smallest variations in food have great influence on the ability of these people to access food. This reality has thus contributed in the context of this master thesis entitled, “Price Movement Analysis of Selected Agricultural Products in Gabon”, to question us on the variations of agricultural product prices in Gabon.

Through this study, it is aimed to understand how agricultural commodity prices behave or fluctuate over time in the main markets of the capital city of Gabon (Libreville). Thus, some problems will be identified and appropriate suggestions will be made. The results of the study are expected to provide the following benefits:

- To help in a better decision making in the designing of agricultural projects,
- Provide market information to investors and producers wishing to settle in Gabon,
- To enable relevant groups to use "information from seasonal and long-term change in product prices" on one hand, and learn the functioning of the agricultural products markets in Gabon on the other hand,
- To help consumers using the research findings to optimize their consumption according to their purchasing power.

This work will be based on the data produced by the Gabonese Institute of Development Support (IGAD), to provide results on the prices of the selected twelve (12) economically important and highly demanded agricultural products at the Libreville market. Then, the following main parts will attract our attention:

- Analysis of annual and monthly fluctuations in the prices of selected crops,
- The formulation of suggestions to help better dealing with the phenomena related to food prices in Gabon.

2. PREVIOUS STUDIES

Agricultural product price analysis has already been the subject of several studies with various objectives and methodologies in the world. In the present work, a general literature review has been done.

Minkoua et al, (2010), in their study on “Les Déterminants de l’Instabilité du Prix des Produits Vivriers au Cameroun” analyze the price instability and the determinants of the price movements for tomato, plantain and potato in Douala and Yaoundé markets. With statistical and econometrical approaches, the descriptive results showed that, the prices of fresh products on Yaoundé and Douala markets were more volatile than those of storable substitutes, with the exception of cassava derivatives in the Douala market. It also appeared that, the price of gasoline for the transport of these food products has a significant effect in the explanation of their prices. However, changes in sub-regional demand (CEMAC) have little effect on urban price instability except for plantain in Douala. These results call for the activation of technological research that improves storage capacity or reduces the transport costs of food products mainly through lower fuel prices.

Ntsama (2014), in the doctoral thesis entitled “Le Commerce Agricole entre le Cameroun et les Pays de la CEMAC” has worked on the volatility of agricultural product prices in particular and food in general. This work showed the link between the volatility of food prices and the vulnerability of households in African countries and particularly those of CEMAC. In the part of the economic integration of CEMAC countries, it was demonstrated that, the countries with large oil rents and that quickly asphalt their roads are accelerating the demand on the markets. However, the low endowments to the agricultural activities of these countries expose them to a high food dependency and contribute to a strong price imbalance of these products in the sub-region. Gabon and Equatorial Guinea being the most concerned by this fact. The study also points out that Cameroon alone accounts for 70% of CEMAC's intra-community agricultural trade and urban

households seem to be the most affected by food price shocks due to insufficient supply of food products.

Dembele et al (2008), prepared a research as part of a training course in Cotonou (Benin) titled as “Module de Formation à l’Analyse des Prix Agricoles”, the authors of the paper presented a set of methods whose objectives were to describe the process of determining agricultural product prices as well as the various analytical tools. The work is in the form of an instrument to help the price analysis of agricultural products in West Africa, including cereals (millet, sorghum, maize, rice etc.). This document aims to help market information systems (MIS) to deepen price analyses to improve food security policies in the West African space. The work is divided into four main sections: the determination and discovery of agricultural prices, the different components of the evolution of agricultural prices over time, relative prices and their use, and the calculation and use of parity prices.

Vinayak et al (2015), in the work entitled “Onion Price Forecasting in Hubli Market of Northern Karnataka Using ARIMA Technique”, analyze onion prices at their disposal to determine the future prices at the market in Hubli, northern Karnataka, with onion arrivals being considered the highest in this market. Time series data on the monthly onion price required for the study were collected and were from 1996-1997 to 2010-2011. With ARIMA model, the results of forecasting revealed an increase in the onion prices and demand in the future years. Hence, farmers need to plan the production process in such a way that good price for the produce could be expected.

Polat (2010), as part of obtaining his master's degree, has done a study entitled “Analysis of Adana City Wholesale Prices of Fresh Fruits and Vegetables”. In the study, an analysis was done to show the relations among the prices and the amount of some fresh fruits and vegetables, which were present in Adana city Wholesale Market for Fresh Fruits and Vegetables during the year 2008. Twelve (12) products of which trading volumes are the highest in the

Wholesale Market for Fresh Fruits and Vegetables attached to Adana City Metropolitan Municipality were concerned. The relations between the amount of each fresh fruit and vegetable brought to Wholesale Market and formed prices were analyzed. The structure of price formation in seasonal, monthly, weekly and daily periods was assessed. Daily, weekly, monthly and seasonal price fluctuations defined in selected fresh fruits and vegetables were included in the study. As a result, the increase in the amount of production of the products was found to reduce the price of them.

Demirtaş and Erkan (2002), have done one study entitled "Analysis of Tomato Prices in Mersin Province Between 1988 and 1997", published in "Alatarım" journal. The study consisted of analysis of wholesale prices of tomato between 1988 and 1997. To do this, real and current prices were discussed during the decade analyzed. The causes, movements and levels of price fluctuations were explained. As a result, it was found that the real prices of tomato had reached maximum prices in February and March, and minimum prices were realized in September. In this period, the variation coefficients of prices were determined and it was found that March was the most suitable month to supply tomato to the market.

Özkan et al, (2003), in their study titled as "An analysis of Citrus Prices", made an analysis on the orange, lemon, and mandarin prices received by farmers. This work used the prices during the period 1982 to 1998 in Turkey and had an objective of the examination of the annual price fluctuations. Then, for the seasonal price fluctuations, authors used wholesale prices of Antalya for the same fruits, and calculated marketing margins for the period of 1994 to 2001. With the statistical and graphical approaches, the main result of the study showed that the prices of fruits used in the study were increasing.

Kan and Direk (2004), in their study entitled "Course of Red Meat Prices in Konya Province", have analyzed prices of red meat between 1995-2003 at Konya State Meat and Fish Organization. Seasonal fluctuations of red meat prices

in Konya city were also analyzed. The findings of the research, in the period discussed above, showed that, real red meat prices according to base year were decreased by 18.12%. In the same time, the aim of determining seasonal fluctuations in real prices of red meat between 1995-2003 reveals important seasonal fluctuations. According to the results of the research, it also appeared that real meat prices were above the seasonal average in July, August and September, but lower in April, May and February.

Şahin et al (1996), in their study titled as "Developments of the Cotton Prices and Factors Effecting the Prices of Cotton in Turkey", observed that, the amount of cotton export was decreasing year by year since increase rate of cotton production was not high and despite of this, development of textile sector and increase in the cotton prices were observed in Turkey. The authors explain that, since 1966, date when the starting and nonstop increase of government support policy of raw cotton, price support in general has remained above inflation. This situation has created a result of high prices of cotton in support purchases. The study concludes after statistical analysis of cotton prices to determine annual trend equations with method of least squares and seasonal movement related that, in general observations, the cotton price trend were higher by months. The cotton obtains its lowest prices in November while the highest is seen in August.

Öztunç (1987), to obtain his master degree made a study entitled "Analysis of Citrus Wholesale Prices in Adana City". In this study, the author analyzes the changes in the citrus fruit prices, and proposes their futures prices by using some equations (logarithmic, exponential etc.). It were also exposed the main reasons that cause price changes in Adana province in 1980 to 1986 period. According to the results of this study, lemon and grapefruit prices have showed daily, monthly seasonal and annual fluctuations, and these fluctuations were explained by both amount of production and inefficient marketing system.

Ukav (1994), in the study titled as "Analysis of Wholesale Prices of Grapes in Tarsus District" that concerned the period 1983 to 1992, analysis of the

price changes of grapes and the aim to determine the main reasons that cause these changes in the Tarsus district were done. Thus, with the collected wholesale market prices of fresh fruits and vegetables, the results of this work showed that, the price of Tarsus Beyazi and Kardinal grapes had shown daily, monthly, seasonal and annual fluctuations. June and September were the months where prices were highest and harvests occurred in July and August. In the last part of this study, the reasons for these fluctuations were attributed to the amount of production and inefficient marketing system.

Gizir (2002), in Çukurova University, did a research study titled as "Analysis of Regional Cotton Prices in Adana". The study focused on regional cotton prices, including Ege Std-1 and Çukurova Std-1 (B), which were grown in the Aegean and Çukurova regions of Turkey. Regional cotton prices were also compared to Liverpool cotton (A) index as a World cotton price in 1970 to 2001 period. The results of this study showed increases in both Ege Std-1 and Çukurova Std-1(B) current prices and decreases in their real prices according to their respective trend lines. Liverpool cotton prices index had a positively sloped trend line in the 1970-2001 period and a slightly seasonal fluctuations were observed.

Koç (2014), made a research entitled "A Research on Undulations of Price of Seedless Raisin and These Effects in AEGEAN Region" in January 2014. This study was carried out with the objective of determining the factors affecting formation of seedless raisin prices at İzmir Trade exchange. The research showed various dimensions of the effects of the monthly fluctuations of seedless raisin prices that occurred during the years. It has been also attempted to determine the actions that should be implemented by Turkey, which is a potential member of EU. Finally, suggestions were given to prevent the producers from negatively affected by the changing seedless raisin prices in Turkey.

Gül et al (2009), in their work "The Development and the Seasonal Fluctuations of Some Vegetable Prices in Antalya City", made an analysis on sixteen different vegetable price for the period 1997 to 2006, to see their

development and seasonal fluctuations. The work also presents the monthly fluctuations of these vegetables in real terms and then, the trend of the seasonal fluctuations. Finally, the study concludes that the general movement of trend is regressing in the considered period but this decrease appears severe for some vegetables. These results are important to ensure that the producers will get high prices and benefit when offering products to the market.

Gül and Özdeş (1997), in their analysis of wheat and cotton prices which are included public price support program and onion and potato which government has no effect on price making process. The work is entitled "Instability of Agricultural Crop Prices" and the time series data concerned are from 1941 to 1994. The authors showed in the results that, although wheat and cotton have been supported for a long time, instability of their prices is greater than those of onion and potato. These results were obtained by statistical and graphical approaches (trend lines, equations). At the end of this work, writers recommend that either the efficiency of supporting policies should be increased or new mechanisms allowing price formation through time such as futures markets for price instability should be encouraged.

Göncü and Özkütük (1999a), in their study titled as "The Comparison of the Milk, Meat, Cheese and Live Cattle Prices Parities to Some Product Prices and Criteria", analyzed wholesale price of meat, milk, cheese, live cattle for eleven years from 1987 to 1997. Parities for prices of these products together with the prices of concentrate feed, wheat, American Dollar currency and wages at manufacturing industry were evaluated. The authors compared wholesale prices of milk to the other products. Except wages in manufacturing industry the comparing criteria showed a decreasing trend during 1992 - 1997 period. The result of this study showed that, prices of all animal products were fluctuating between years and had general instability during the period investigated.

Göncü and Özkütük (1999b), in the study titled as "The Variation at Retail Prices of Meat, Cow Milk, Cheese and Yoghurt among Provinces in Turkey",

based on 1996 retail prices of some products from DIE 1998, the rank of provinces in terms of averages was examined. Considering maximum and minimum prices, the variation in milk prices was 32 units but this variation was smaller than variation in cheese and yoghurt prices. However, this variation was larger than that of meat but not as high as that of cheese and yoghurt. The maximum white cheese and yoghurt prices were about twice as much of minimum prices and the study reveals three (3) provinces in which prices were high concerning cheese, meat and yoghurt.

3. MATERIAL AND METHOD

3.1. Material

Research Area: Gabon has approximately 5 million ha of fertile land. It is a country having very low population density in sub-Saharan Africa. Gabon has about 1.8 million population but about 86% of the people are concentrated in major urban cities: Libreville, Port-Gentil and Franceville. Libreville has the greatest percentage of the population. It is one of the reasons that motivated to choose Libreville as the research area.

Data Sources: The main data (retail prices of all selected crops) for this study were obtained from the Gabonese Institute for Development Support (IGAD). IGAD is an agency of the Gabonese Ministry of Agriculture and Livestock. It is in charge of the implementation of agricultural projects in Gabon. IGAD has a market information system that allows the monitoring of agricultural product prices Consumer prices of the selected twelve agricultural commodities (see Appendix I) were obtained from IGAD Market Information System (SIM) for the period 2005-2015. Data availability also played an important role in selecting time period. The World Bank is other data source. Consumer price index series used to deflate prices in this research were obtained from the World Bank. (World Bank, 2017). It would have been better to deflate prices by using Libreville indices, since living conditions in each city differ greatly. However, since the majority of the population lives in the capital Libreville, hence consumption are concentrated, no other indices are available. Gabon indices were used despite the disadvantages.

In order to make this study more relevant and sufficient, data and reports from other studies, theses, articles and other reports, whether officially published or not, were also used. Prices used are in CFA Franc which value is fixed with Euro (One Euro=650.58 CFAF).

Selected Crops: Twelve crops were selected for the analysis. These crops were classified by their properties into four groups: Aromatic-leafy crops (basil,

celery), leafy crops (amaranth, black nightshade, lettuce and roselle), vegetable-fruits (pepper, tomato, white eggplant) and staple crops (cassava tuber, fang cassava leaf roll, plantain). Data availability did also play an important role in selecting crops.

3.2. Method

Time series analysis was employed in this study. If the value of a variable is observed at different times and recorded, the data collected forms a time series. Time periods may be years, months, weeks, days, hours etc. In time series, the independent variable is time. Time series are analyzed to reveal patterns that will help to forecast future. However future is not always like past. Forecasts should be used with the aid of some specific formal procedures and judgments (Hanke and Wichern, 2014).

Time series data are made up of four different components: Trend component indicating long term behavior of time series, seasonal component reflecting seasonal (or monthly) fluctuations, cyclical component which are irregular fluctuations covering more than one year and occurring due to economic conditions, and irregular or random element created by unexpected events such as wars, droughts etc.

3.2.1. Trend Analysis

Three models were created in order to estimate trend equations: linear, quadratic and cubic. Both current and real prices were used in estimating the parameters of these models. Hence, a total of six models were employed (three for the current prices, and three for the real prices). The Least Squares Method was used as the main methodology. SPSS and Excel software were employed to analyze data. Using statistical and practical criteria, linear models were selected and used in further analysis.

Price-Trend Models: First of all, data were plotted using Excel to determine the nature of price movements.

The following criteria should be kept in mind when constructing price-trend models:

- Model is based on the relation between observation results and time.
- Functional relation can be linear or curvilinear.
- The difference between the observed and estimated values (theoretical values) should be minimal. In the distribution diagram, it is the line that passes through the observed points with minimum sum of squared differences.

As it can be seen, these criteria allow us to obtain a better trend line as well as the lowest standard error and provide other good statistical properties. In fact, to take into consideration these criteria, SPSS can help us and gives details to make a good choice. There are several trend models:

- Linear trend (Y=a+b*X) for series that do not change the direction of the movement, that are constantly increasing or decreasing, and if the direction of increase is approximate.
- Exponential trend (Y=a*bX) to those whose rate of increase or decrease is fixed.
- If there is a direction change in the course of the graph, parabola (quadratic function) is used.
- If there are two curves in the course of the graph (before rising and then descending then rises again or before it descends, then rises and then rises again) cubic function is employed.

Third and higher-order functions may also contain conjuncture with trend fluctuations, for this reason, they do not fully represent the trend. In this case, it is appropriate to divide the observations into two parts. In the present work, to make a good choice, refer to SPSS has been preferred.

The years showing the time are taken as an independent variable because they change freely without depending on anything. Observations are dependent variable. In our method, time values should not be shown with values like 1990, 1991, 1992. Any variable of numbers that maintain the differences can be used. In practice, however, the median year is set to zero (0). The years before the median year take values such as -1, -2… The years after the median year are +1, +2...

- If the number of years in the series is an odd number, the total years is zero. The sum of their single power or degree (cube, power five, etc.) is zero and the following figure is given, …, -2, -1, 0, 1, 2, … (these numbers represent X values).
- If the number of years in the series is an even number, there is no single year in the middle. Midpoint is located between two consequential years. In this case, at the middle of two years, one (1) is given and increased 1 and -1 in reverse direction. The other years are increased by 2 points in one way and 2 points also in the reverse direction. The X values take values such as, …, -5, -3, -1, +1, +3, … Here, the sum of the X values is zero. Thus, two units represent one-year period.

X is obtained as in the explanations above and Y represent value of current or real price. Then, to obtain variables “a”, “b” and “c” parameters of the trend equation, the following relations are used:

- For linear trend equation in the form Y= a + b*X, to obtain "a" and "b" variables, the following equation is used:
-

$$a = \frac{\sum Y_t}{n}$$

$$b = \frac{\sum X_t * Y_t}{\sum X_t^{\,2}}$$

- For exponential trend equation in the form of $Y=a*b^X$ or exponential trend equation, parameters "a" and "b" are estimated to use in the equation: LN(Y) =LN (A) +LN (B)*X.
- For the second order or quadratic equation, in the form of ($Y=a+b*X+c*X^2$), parameters a, b, and c are obtained to be used in the following equations:

$$\sum Y_t = n * a + c * \sum X_t^{\,2}$$

$$\sum X_t * Y_t = b \sum X_t^{\,2}$$

$$\sum X_t^{\,2} * Y_t = a \sum X_t^{\,2} + c \sum X_t^{\,4}$$

According to the methodology, when the number of the observations is less than 30 as in this work, there are eleven (11) years (N) to obtain the standard error the new n is determined as: (n) = (N-2) = (11-2) = 9, so, the used (n) will be nine (9). If the number of observations is thirty or more, a different (n) value is used as (N -1) instead of (N-2). To determine the standard error, estimated prices are subtracted in current prices (Cu-E) and the total square of these results is determined ($(Cu-E)^2$).

After dividing $(Cu-E)^2$ by the (n) explained above and the square root of this result is the standard error.

After estimating coefficients of the equations, Excel was used to draw graphs and their trend lines. Finally the linear equation model was chosen and used in further analysis.

3.2.2. Indices

In this part, calculations are grouped in tables to determine certain indicators that will help to deepen our analysis. Following indices were created to this end: Simple Indices that is used to show, how the price behaves compared to the base year price (2005). To determine Simple Index, each annual price of the selected product is divided by the base year's price and the result is multiplied by hundred (100). Chain indices were also formed. Chain Index represents the variation of the price of each year. It is calculated by dividing the price of each year by that of the previous year and multiplying the result by hundred (100). In this section, real prices were also calculated. Firstly, base year of the World Bank index series is changed to fit the time series in hand.

Among the indicators calculated, the dates when the prices reach their maximum and minimum points were also identified. This, methodology was also used as in the following previous studies (Gizir, 2002; Ukav, 1994; Demirtaş and Erkan, 2002).

3.2.3. Cyclical Component

This indicator is obtained by dividing the current price with the trend (T). This relation can be verified by using the multiplicative relation (y= T* S*C*I). With annual data, seasonal component (S) does not affect the relation, since it is eliminated by taking averages. Thus, the equation takes the form of y=TCI and since random component (I) cannot be eliminated it is considered together with the

cyclical component as one component. Consequently, the relation obtained gives: y/T=CI (y=observed price; T= trend; C=cycle; I=random or residual) (Özer, 2010).

3.2.4.Monthly Fluctuations

In monthly (or intra-annual) price analysis section, the phenomenon of seasonal variations in product prices is discussed. For this, statistical approach was used to determine monthly price changes during the year. Such an approach allows to measure price fluctuations with certain indicators among which, corrected seasonal index and some coefficients related to these price variations. To do this, X coefficient obtained from linear regression models is used. Monthly fluctuations include annual trend and it should be eliminated before the analysis. Therefore this coefficient (showing annual increase or decrease) was divided by 24 to find 15-day changes caused by the trend. Since number of months is an even number correction coefficients goes as 1, 3, 5, and to remove the trend, the correction series should be reversed to get 15 days correction.

To obtain corrected price index basic arithmetic average and sum calculations were used. The calculation consist to divide the coefficient of X obtained in the regression equation by twelve (12) and again by two (2), the obtained result is the “Correction”. Correction is multiplied by the corrected coefficient to obtain “total correction”. After this, the monthly average price in the period is added with total correction to get “corrected mean”. And corrected mean is divided by the total of sum of the corrected means and the result is expressed as percentage. To have the coefficient of variation, the standard deviation of each month over the period is used and is divided by the mean of related price. The standard deviation expresses the dispersion of the data around the average. The lower the figure, the more uniform the data, which means that most of the observations are closed to the average. The higher the standard deviation, the greater the dispersion of the observations around the average. This means that there are bigger differences between the data that can be observed. The bigger the

coefficient of variation, the more important the standard deviation from the average, and vice versa.

To perform this work, SPSS statistical program and the Least Squares Method for regressions were used and the linear equation model has been retained to plot and determine values of trends. Then, basic statistical methods were used to get certain indicators to better understand and explain the price movements during the study period.

4. RESULTS AND DISCUSSIONS

To make the presentation easier, selected crops were classified into four groups by their nature: (aromatic leafy vegetables, leafy vegetables, vegetable fruits and staple crops). For all the crops, several trend models (linear, quadratic and cubic models) were developed and linear model was adopted for the reasons mentioned in the Materials and Methods section.

4.1. Aromatic Leafy Vegetables Group.

4.1.1. Basil

Figure 4.1. Basil (*Ocimum Basilicum*)

Basil belongs to the genus *Ocimum*. It is an annual plant of the mint family, (*Lamiaceae*). This plant is native to tropical regions from central Africa to Southeast Asia. Basil grows wild as a perennial crop and most often used as a leaf vegetable. Basil does not tolerate water stress and needs to be watered regularly and also prefers full sun. It is highly sensitive to frost and needs protection against freezing temperatures. There are several uses of basil. In worldwide cultures and cuisines, it is mostly used as fresh leaf vegetable in recipes and is generally added at the last moment, as cooking quickly destroys the flavor (Sullivan, 2009).

4.1.1.1. Trend Analysis for Basil

Table 4.1. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.254	0.161	0.802	-0.111	-0.245	0.756
F	4.4*	1.957	14.503***	0.002	0.017	11.326***
Std. Err.	311.354	330.214	160.368	262.208	277.53	122.893
D-W	1.265	1.259	1.462	1.301	1.276	1.538
Cons.	2855.786***	2851.715***	3146.915***	2552.943***	2535.567***	2789.51***
X	62.271*	62.271*	62.271***	-0.973	-0.973	-0.973
X^2	-	0.407	-102.093***	-	1.738	-86.278***
X^3	-	-	4.100***	-	-	3.521***

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

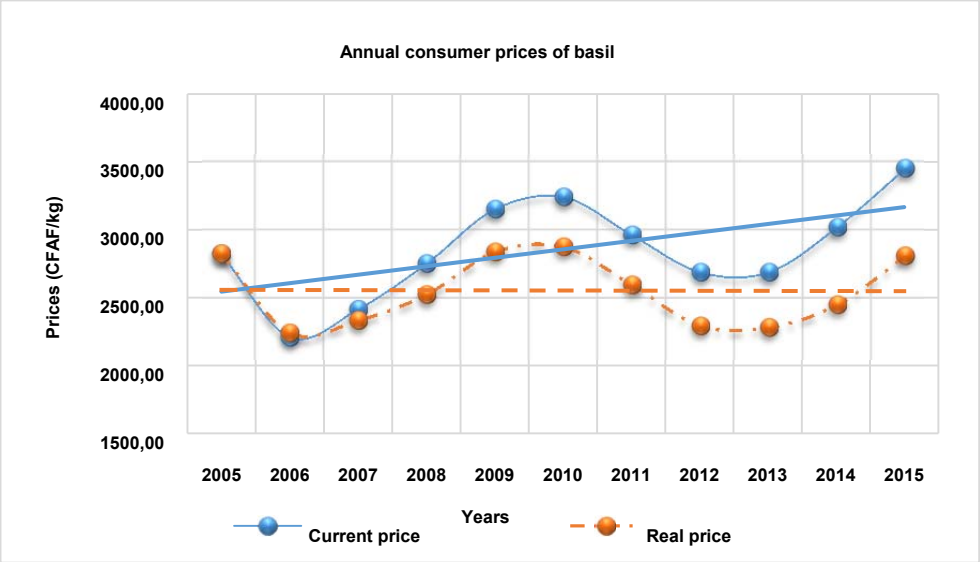

Figure 4.2. Annual Consumer Prices of Basil
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 4.2 shows the annual changes in basil retail prices at Libreville market between 2005 and 2015. There is a continuous instability in prices. As far

as the current price is concerned, the lowest value is observed in 2006 (CFAF/kg 2213.25), and the highest in 2015 (CFAF/kg 3450.83). Regarding the real price, the lowest value is in 2006 (CFAF/kg 2244.89) and the highest in 2015 (CFAF/kg 2809.62). From the data, obtained trend line equations are **Y=2855.79+62.27X** for the current price and **Y=2552.94-0.97X** for the constant price. Thus, by using these equations, it is possible to forecast the future approximate prices of basil. Considering the same period (2005-2015), the following tables present more details.

Table 4.2. Changes in Annual Consumer Prices of Basil (Current)

Years	Current price	Simple index	Chain index	Estimation	(Cu/E)*100
	CFAF/kg	2005=100		(CFAF/kg)	
2005	2825.42	100.00	100.00	2544.47	111.04
2006	2213.25	78.33	78.33	2606.74	84.90
2007	2418.50	85.60	109.27	2669.01	90.61
2008	2752.58	97.42	113.81	2731.28	100.78
2009	3151.58	111.54	114.50	2793.56	112.82
2010	3240.58	114.69	102.82	2855.83	113.47
2011	2962.58	104.85	91.42	2918.10	101.52
2012	2689.33	95.18	90.78	2980.37	90.23
2013	2689.25	95.18	100.00	3042.64	88.39
2014	3019.75	106.88	112.29	3104.91	97.26
2015	3450.83	122.14	114.28	3167.18	108.96

Source: (Author's calculation from data)

Table 4.3. Changes in Annual Consumer Prices of Basil (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	2825.42	100.00	2825.42	100.00	100.00	2557.83	110.46
2006	2213.25	98.59	2244.89	79.45	79.45	2556.85	87.80
2007	2418.50	103.55	2335.57	82.66	104.04	2555.88	91.38
2008	2752.58	109.00	2525.29	89.38	108.12	2554.91	98.84
2009	3151.58	111.06	2837.80	100.44	112.38	2553.94	111.11
2010	3240.58	112.68	2875.92	101.79	101.34	2552.96	112.65
2011	2962.58	114.11	2596.26	91.89	90.28	2551.99	101.73
2012	2689.33	117.15	2295.68	81.25	88.42	2551.02	89.99
2013	2689.25	117.71	2284.64	80.86	99.52	2550.05	89.59
2014	3019.75	123.19	2451.28	86.76	107.29	2549.07	96.16
2015	3450.83	122.82	2809.62	99.44	114.62	2548.10	110.26

Source: (Author's calculation from data)

The Table 4.2 shows the variations of basil current consumer prices. In trend line equation for basil current prices, 62.27X means that unit price of basil increases 62.27 CFAF each year. However, in the case of real prices (deflated prices in the Table 4.3) trend is different. This means that prices of basil is decreasing 0.973 CFAF each year in terms of real prices. Average change of retail prices of basil during the study period are 1.83% and -0.05% for the current and real terms, respectively. However, in some cases just considering the beginning and ending year prices may be misleading. During the years within this study period, there are great fluctuations and the prices seem to alternate around the trend lines (cyclical variation) every three years.

4.1.1.2. Monthly Fluctuations in Basil Prices

Table 4.4. Monthly Fluctuations in Basil Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	2712.36	-11	2.59	-28.54	2683.82	94	17
February	2878.00	-9	2.59	-23.35	2854.65	100	22
March	3004.18	-7	2.59	-18.16	2986.02	105	17
April	2945.00	-5	2.59	-12.97	2932.03	103	14
May	2769.18	-3	2.59	-7.78	2761.40	97	18
June	2860.09	-1	2.59	-2.59	2857.50	100	23
July	2724.09	1	2.59	2.59	2726.69	95	14
August	3014.00	3	2.59	7.78	3021.78	106	15
September	2699.82	5	2.59	12.97	2712.79	95	14
October	2805.73	7	2.59	18.16	2823.89	99	18
November	2882.82	9	2.59	23.35	2906.17	102	20
December	2974.18	11	2.59	28.54	3002.72	105	14
Mean	2855.79	0.00	2.59	0.00	2855.79	100.00	

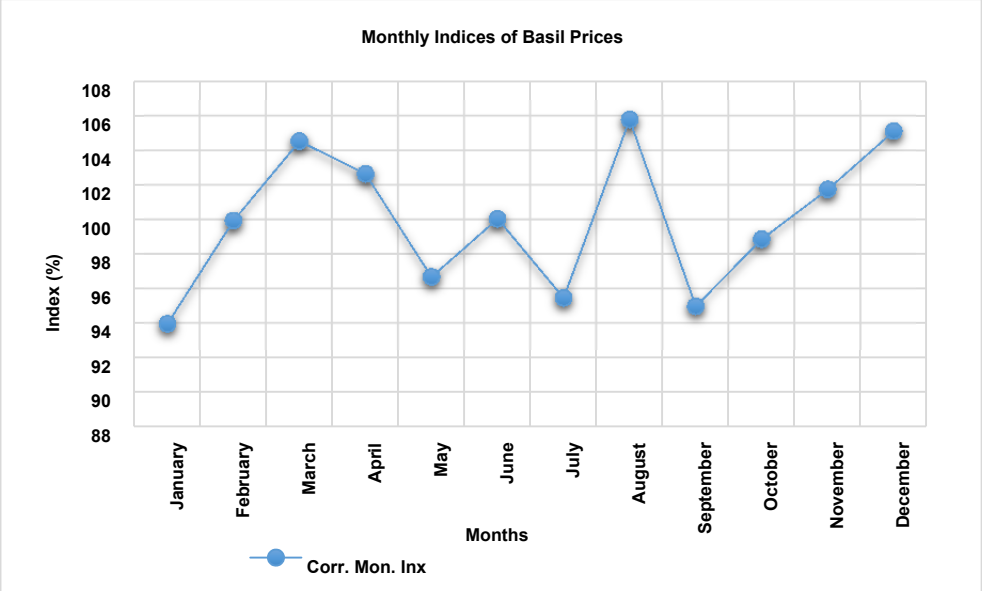

Figure 4.3. Monthly Indices of Basil Prices

The Table 4.4 illustrates basil monthly price movements. The highest price variations are observed from February to April. The other months of the year have relatively lower prices compared to the average of the annual prices except for the months of August, December and March, which are also 6%, 5% and 5% above the mean annual price respectively. The month of January, with 6% lower than the mean annual price, has the lowest value while August registered the highest price, which is 6% above the mean annual price. Considering the coefficient of variation column, the highest monthly price variations during the years are visible in June. Prices of vegetables are governed by the law of supply and demand. For many products, seasons have an impact on the demand for this product and this situation makes the prices differ according to the seasons. In agricultural products, supply is concentrated during the harvest season thus; seasonal fluctuations in prices caused by supply adjustment delays due to low supply elasticity and continuous demand throughout the year are widely observed. On the Figure 4.3 above, the price variations of this fresh vegetable may be explained by the seasonal patterns due to

seasonal changes in availability described above. The evolution of the prices of this product seems thus affordable for the consumers during the months whose prices are below the annual average price. However, given the lack of economic and agronomic information (production cycle, import-export, etc.) related to this crop under the specific conditions of Gabon, it would be necessary to conduct further studies to produce these data which are indispensable during the research works.

4.1.2. Celery

Figure 4.4. Celery (*Apium Graveolens*)

Celery is a marshland aromatic plant in the *apiaceae* family. It is grown mostly for its fresh herbs but also for its dried fruits. The center of the domestication of this plant appears to be the eastern Mediterranean region. Celery is an herbaceous annual or biennial herb. The crop requires high humidity and temperatures between 13°C and 24°C. However, it is sensitive to freezing temperatures. This plant presents optimum production when rainfall is well distributed; it is the case of tropical to sub-tropical climate. Celery needs high soil fertility, usually maintained by the application of balanced commercial fertilizers. Celery is mostly used for salad vegetables. Its leaves are frequently used in cooking especially in adding a mild spicy flavor to foods. (Malhotra, 2006).

4.1.2.1. Trend Analysis for Celery

Table 4.5. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
R^2 adj	0.65	0.748	0.716	0.201	0.449	0.378
F	19.551***	15.829***	9.421***	3.517*	5.079**	3.021
Std. Err	247.781	210.239	222.955	232.467	193.01	205.203
D-W	1.134	1.463	1.427	0.958	1.231	1.198
Cons.	2493.787***	2341.510***	2368.157***	2221.857***	2073.695***	2093.968***
X	104.460***	104.460***	104.460***	41.569*	41.569*	41.569*
X2	-	15.228*	-5.975	-	14.816*	7.777
X3	-	-	0.37	-	-	0.282

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

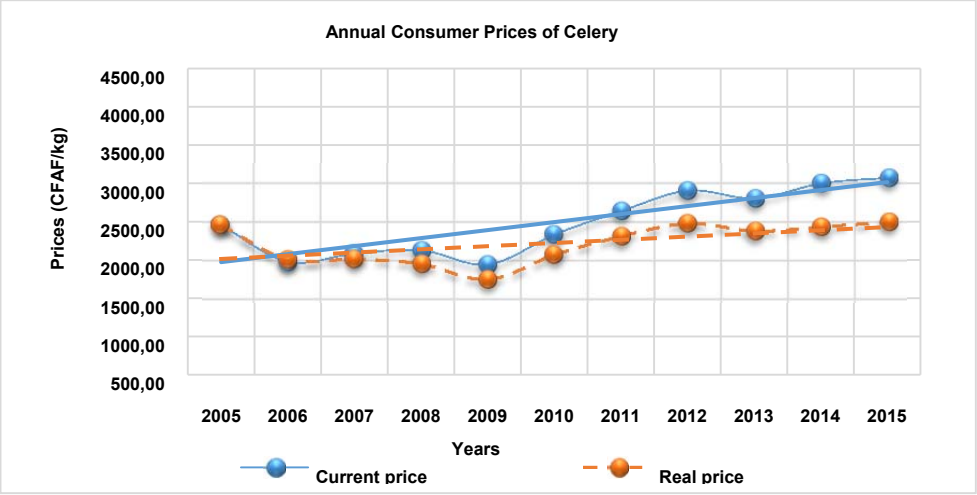

Figure 4.5. Annual Consumer Prices of Celery
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 4.5 shows the annual movements in the retail prices of celery. On this graph, the prices rise and several movements are perceived in the fluctuations. In the year 2009, the current price reaches its lowest value (CFAF 1953.08). The price increases and reaches its highest value in 2015 (CFAF

3075.08). For the real price, the lowest value is registered in 2009 (CFAF 1758.63) whilst the highest is in 2015 (CFAF 2503.69). To forecast celery future prices, the regression model gives the following equations: **Y=2493.787+104.46X** for current price and **Y=2221.86+41.57X** for real price. In general, Celery prices increase over the years and in the following tables, there are more details regarding the price variations.

Table 4.6. Changes in Annual Consumer Prices of Celery (Current)

Years	Current price	Simple index	Chain index	Estimations (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	2466.58	100.00	100.00	1971.46	125.11
2006	1988.42	80.61	80.61	2075.92	95.78
2007	2095.75	84.97	105.40	2180.38	96.12
2008	2137.50	86.66	101.99	2284.84	93.55
2009	1953.08	79.18	91.37	2389.30	81.74
2010	2343.67	95.02	120.00	2493.76	93.98
2011	2646.33	107.29	112.91	2598.22	101.85
2012	2910.92	118.01	110.00	2702.68	107.70
2013	2808.33	113.86	96.48	2807.14	100.04
2014	3006.00	121.87	107.04	2911.60	103.24
2015	3075.08	124.67	102.30	3016.06	101.96

Source: (Author's calculation from data)

Table 4.7. Changes in Annual Consumer Prices of Celery (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	2466.58	100.00	2466.58	100.00	100.00	2013.97	122.47
2006	1988.42	98.59	2016.85	81.77	81.77	2055.54	98.12
2007	2095.75	103.55	2023.89	82.05	100.35	2097.11	96.51
2008	2137.50	109.00	1960.99	79.50	96.89	2138.68	91.69
2009	1953.08	111.06	1758.63	71.30	89.68	2180.25	80.66
2010	2343.67	112.68	2079.93	84.32	118.27	2221.81	93.61
2011	2646.33	114.11	2319.11	94.02	111.50	2263.38	102.46
2012	2910.92	117.15	2484.83	100.74	107.15	2304.95	107.80
2013	2808.33	117.71	2385.81	96.73	96.02	2346.52	101.67
2014	3006.00	123.19	2440.12	98.93	102.28	2388.09	102.18
2015	3075.08	122.82	2503.69	101.50	102.61	2429.66	103.05

Source: (Author's calculation from data)

The Table 4.6 presents the details of celery current consumer price variations. Coefficients of the independent variable (X in our case) in simple regression equations give the annual change in dependent variable. So, celery prices increase 104.46 CFAF each year. However, in constant terms this increase is only 41.57 CFAF. Celery prices increased 24.67% compared to the base year in current terms. However, the real increase during this period is very small. During the study period, current and real annual prices increased on average 2.02% and 0.14% respectively. All these figures show that real increase is just a little bit above the general price level increases (in other words inflation) in Gabon during these years. These are not the prices received by farmers. Therefore, it may be concluded that retailers of celery benefit from this price increase. The price of this crop alternate around of the trend line (cyclical movement) every five years.

4.1.2.2. Monthly Fluctuations in Celery Prices

Table 4.8. Monthly Fluctuations in Celery Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	2507.36	-11	4.35	-47.88	2459.49	99	25
February	2427.64	-9	4.35	-39.17	2388.46	96	22
March	2467.00	-7	4.35	-30.47	2436.53	98	25
April	2417.73	-5	4.35	-21.76	2395.96	96	21
May	2480.27	-3	4.35	-13.06	2467.22	99	21
June	2520.91	-1	4.35	-4.35	2516.56	101	20
July	2681.18	1	4.35	4.35	2685.53	108	23
August	2394.00	3	4.35	13.06	2407.06	97	26
September	2240.55	5	4.35	21.76	2262.31	91	23
October	2666.00	7	4.35	30.47	2696.47	108	22
November	2585.36	9	4.35	39.17	2624.54	105	20
December	2537.45	11	4.35	47.88	2585.33	104	15
Mean	2493.79	0.00	4.35	0.00	2493.79	100.00	

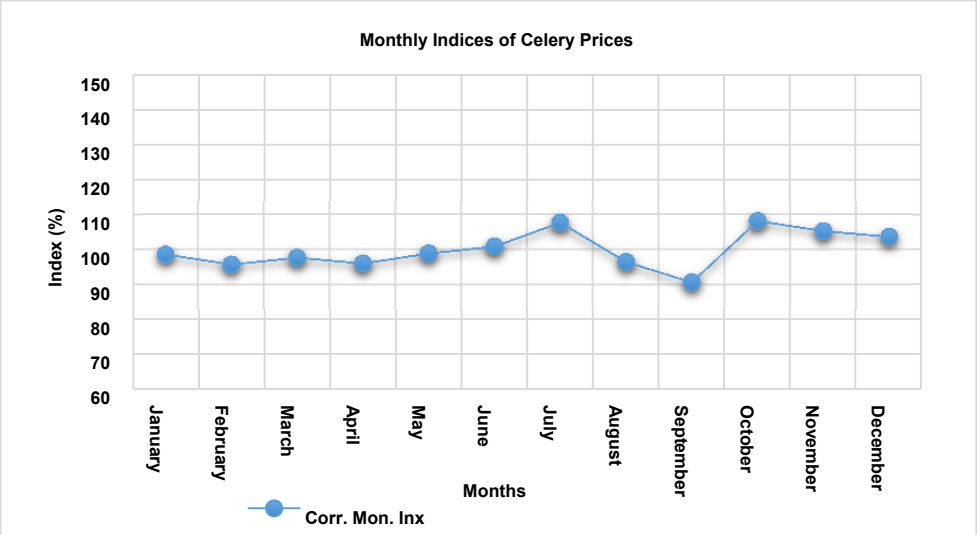

Figure 4.6. Monthly Indices of Celery Prices

The Table 4.8 presents the fluctuations of celery monthly current prices during the years. Thus, September registered the lowest price (91%) that is 9% less than the annual average price meanwhile, July and October, with 8% above the same annual average price, obtained the highest value. The coefficient of variation column shows August has the highest coefficient during the years.

The planting date of this product starts on January as observed in the data from FAO (2018). During the year, the production of this crop can be done and the product needs approximately 90 to 120 days (3 to 4 months) to be harvested. Harvest occurs preferably after the interval time evoked above. According to the FAO's (2018) calendar, prices seem to respect the production cycle and this can be observed through the price movements. During the harvests, low price values are reached, it supposes that supply is higher at these times than during other periods and permits the decrease of the price. In the Figure 4.6, the behavior of prices during the months of August and September could be mostly explained by the supply and demand theory.

Other factors, such as imports, may also help to understand these too low prices. Indeed, for this crop, the report of IGAD (2015), says that 81 tons (36%) were imported from Cameroon; meanwhile the total sale quantity was 223 tons at Libreville market. Thus, the import quantities over the years may also help to explain the sharp drop of the price in August and September in so far as these import quantities at these specific months may contribute to increasing in supply. The results above may suggest that consumers should be attentive to the price of this vegetable in the particular months of August and September, as well as in January and March.

4.2. Simple Leafy Vegetables

4.2.1. Amaranth

Figure 4.7. Amaranth (*Amaranthus Spp*.)

Amaranthus also known as amaranth belongs to the family of *amaranthaceae*; its origin is situated in America and is one of the oldest food crops in the world. There are approximately 60 genus of Amaranth species cultivated as leaf vegetables, grains or ornamental plants, while others are weeds. Amaranth is classified as pseudo-cereals which is cultivated for its edible starchy seeds. But it is not a true cereal such as wheat and rice. Worldwide, amaranth is very important and continues to be produced extensively in both temperate and tropical regions. In places such as Africa, amaranth is mostly used as a pot-herb and in some instances supplies a substantial part of the protein, minerals and vitamins in the diet. Amaranth is a cosmopolitan genus of annual or short-lived perennial plants. Amaranth is often known as drought-tolerant compared to most vegetables. (Anonymous, 2010).

4.2.1.1. Trend Analysis for Amaranth

Table 4.9. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.197	0.346	0.276	0.79	0.799	0.771
F	3.46*	3.644*	2.272	38.578***	20.889***	12.215***
Std. Err.	36.03	32.528	34.216	28.534	27.897	29.792
D-W	1.582	2.087	2.124	1.911	2.184	2.19
Cons.	562.078***	581.446***	587.270***	506.416***	517.749***	519.020***
X	-6.39*	- 6.390*	-6.390*	-16.898***	-16.898***	-16.898***
X^2	-	-1937	-3.959	-	-1.133	-1.575
X^3	-	-	0.081	-	-	0.018

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

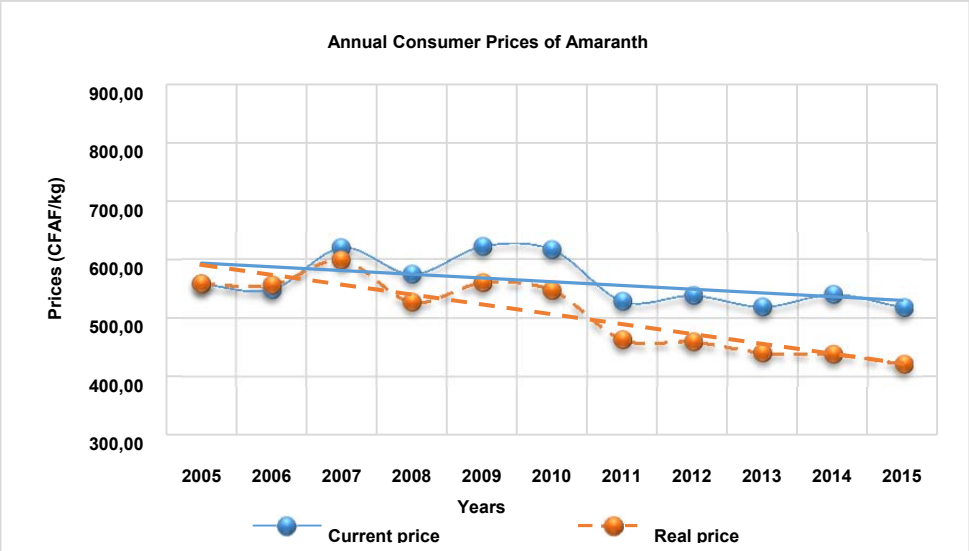

Figure 4.8. Annual Consumer Prices of Amaranth
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 4.8 shows the movements of Amaranth annual current and real prices. The price movements over the years are generally unstable. Concerning the current price, the lowest value was obtained in 2015 (CFAF 517.75) and the highest in 2009 (CFAF 621.92). Regarding the real price, the lowest value is in 2015 (CFAF 421.54) and the highest is in 2007 (CFAF 598.42). The resulting trend line equations of the evolution of these prices are **Y = 562.08-6.39*X** for the current price and **Y=506.42-16.9*X** for the real price. According to the graph, since 2005, Amaranth prices moved along a downward trend line. Indeed, this decline is not substantial but it has allowed obtaining low prices at the end of the study period compared to those initially known in 2005. More details are presented in the following tables.

Table 4.10. Changes in Annual Consumer Prices of Amaranth (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	558.17	100.00	100.00	594.03	93.96
2006	548.42	98.25	98.25	587.64	93.33
2007	619.67	111.02	112.99	581.25	106.61
2008	574.67	102.96	92.74	574.86	99.97
2009	621.92	111.42	108.22	568.47	109.40
2010	616.17	110.39	99.08	562.08	109.62
2011	528.50	94.68	85.77	555.69	95.11
2012	538.42	96.46	101.88	549.30	98.02
2013	518.92	92.97	96.38	542.91	95.58
2014	540.25	96.79	104.11	536.52	100.70
2015	517.75	92.76	95.84	530.13	97.67

Source: (Author's calculation from data)

Table 4.11. Changes in Annual Consumer Prices of Amaranth (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	558.17	100.00	558.17	100.00	100.00	590.90	94.46
2006	548.42	98.59	556.26	99.66	99.66	574.00	96.91
2007	619.67	103.55	598.42	107.21	107.58	557.10	107.42
2008	574.67	109.00	527.21	94.45	88.10	540.20	97.60
2009	621.92	111.06	560.00	100.33	106.22	523.30	107.01
2010	616.17	112.68	546.83	97.97	97.65	506.40	107.98
2011	528.50	114.11	463.15	82.98	84.70	489.50	94.62
2012	538.42	117.15	459.61	82.34	99.23	472.60	97.25
2013	518.92	117.71	440.84	78.98	95.92	455.70	96.74
2014	540.25	123.19	438.55	78.57	99.48	438.80	99.94
2015	517.75	122.82	421.54	75.52	96.12	421.90	99.92

Source: (Author's calculation from data)

Both coefficient of trend line equations and graphs drawn indicate that amaranth prices are declining during the study period both in current and real terms. Each year amaranth retail prices are decreasing 6.39 CFAF in current terms and 16.9 CFAF in real terms. Amaranth annual price variations during the research period give an average of -0.68% and -2.52% for current (Table 4.10) and real (Table 4.11) prices respectively. Decreases in real prices are greater than that of current prices. This shows that amaranth retail prices stay below the general retail price level in Gabon. Amaranth is one of the products supported by the PRODIAG project launched by IGAD in 2011 (Anonymous, 2016). It is easily seen that prices are continuously declining after the start of the project. Project may have contributed to the promotion of the supply of this product (hence lower prices for the consumers). However, this is a point requiring further research. It may be concluded that, relatively easy cultivation, frequent harvests, low investments and PRODIAG project supports may be contributing factors to promoting amaranth supply, hence lower prices in Gabon.

4.2.1.2. Monthly Fluctuations in Amaranth Prices

Table 4.12. Monthly Fluctuations in Amaranth Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	530.00	-11	-0.27	2.93	532.93	95	17
February	528.82	-9	-0.27	2.40	531.21	95	11
March	545.09	-7	-0.27	1.86	546.95	97	9
April	567.73	-5	-0.27	1.33	569.06	101	11
May	579.36	-3	-0.27	0.80	580.16	103	13
June	584.55	-1	-0.27	0.27	584.81	104	14
July	575.09	1	-0.27	-0.27	574.82	102	15
August	564.91	3	-0.27	-0.80	564.11	100	12
September	539.91	5	-0.27	-1.33	538.58	96	8
October	563.18	7	-0.27	-1.86	561.32	100	15
November	573.18	9	-0.27	-2.40	570.79	102	12
December	593.09	11	-0.27	-2.93	590.16	105	12
Mean	562.08	0.00	-0.27	0.00	562.08	100.00	

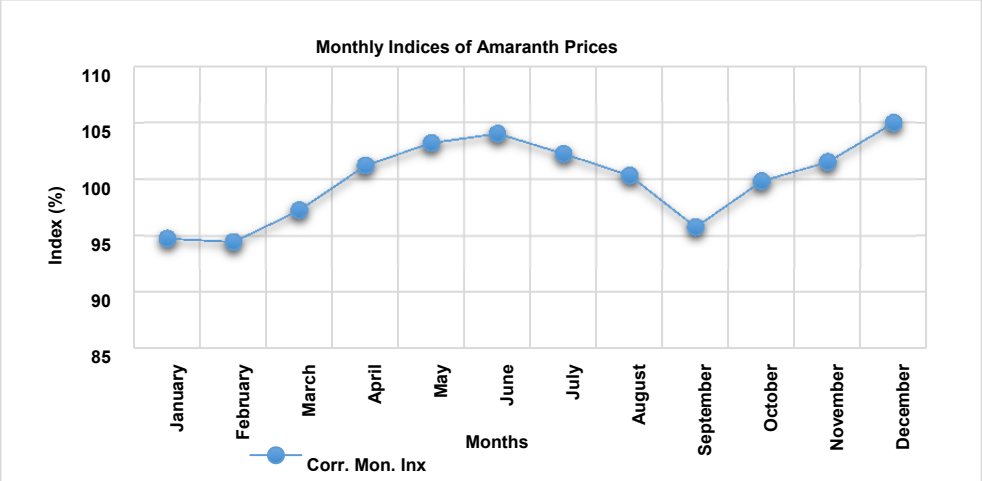

Figure 4.9. Monthly Indices of Amaranth Prices

The Table 4.12 shows amaranth monthly price variations. Over the year, Amaranth prices change as it is shown in the corrected monthly index column. December registered the highest monthly price with 5% above the mean annual

prices. The lowest amaranth prices were observed in January and February. During these months, amaranth prices are 5% below the annual average prices. The coefficient of variation was greater in January compared to those of other months. This means that, there are higher price variations in January as compared to the level of fluctuation of other months. Changes in monthly price indices for this product were plotted in the Figure 4.9.

4.2.2. Black Nightshade

Figure 4.10. Black Nightshade (*Solanum Nigrum*)

The s*olanaceae*, to which the genus *solanum nigrum* belongs, is native to Eurasia and introduced in the Americas, Australasia, and Africa. *Solanum* L. is a cosmopolitan family that aggregates many vegetables and fruits such as potatoes, tomatoes, eggplant (aubergine). Black nightshade or *solanum nigrum* is a leaf vegetable; parts of this plant can be toxic to livestock and human. However, it is often used as food or traditional medicine in some locales. In its medicinally use, several ailments can be managed, such as pneumonia, aching teeth, stomach ache, tonsillitis, wing worms, pain, inflammation, fever, tumor and so one. The plant is usually grown in moist habitats in different kinds of soils, including dry, stony,

shallow, or deep soils and can be cultivated in tropical and subtropical agro-climatic regions. *Solanum nigrum* are mostly grown in both high and lowland areas in West and East Africa, particularly in Nigeria and Cameroon. The leaves of african nightshade are eaten as a cooked vegetable, sometimes mixed with other vegetables (Kuete, 2014).

4.2.2.1. Trend Analysis for Black Nightshade

Table 4.13. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.318	0.261	0.47	-0.077	-0.168	0.143
F	5.670**	2.762	3.951*	0.287	0.28	1.558
Std. Err.	96.509	100.514	85.133	81.105	84.481	72.342
D-W	1.256	1.347	1.441	1.317	1.409	1.506
Cons.	798.037***	816.739***	878.283***	712.379***	728.043***	778.795***
X	21.911**	21.911*	21.911**	4.141	4.141	4.141
X2	-	-1.87	-23.240*	-	-1.566	-19.189*
X3	-	-	0.855*	-	-	0.705*

Where: *** ($p<0.01$); ** ($p<0.05$); * ($p<0.10$)

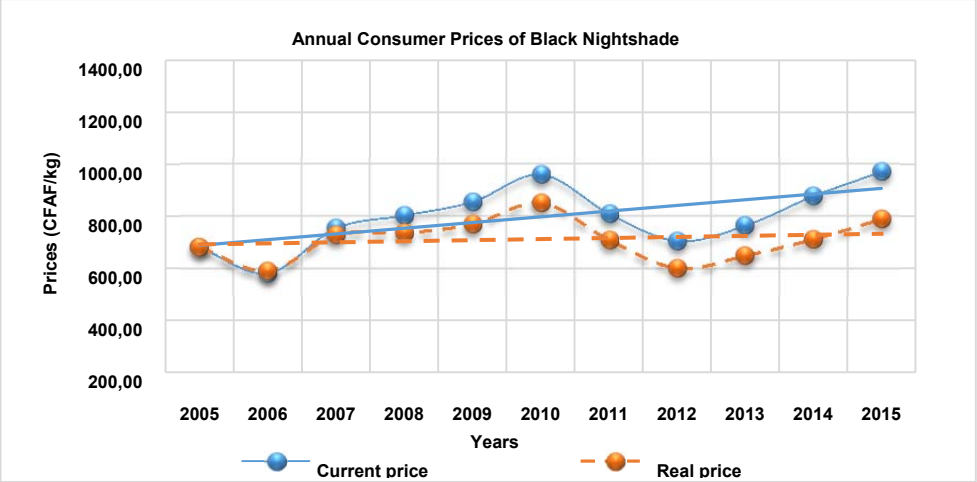

Figure 4.11. Annual Consumer Prices of Black Nightshade
Source: (IGAD data, Libreville's consumer prices, 2016)

The figure 4.11 presents the graph of black nightshade current and real (constant) prices. Over the study period, as for current prices, the lowest price was registered in 2006 (CFAF 584.33) meanwhile the highest price was in 2015 (CFAF 971.58). The price evolution was irregular (fluctuated) and increased. The same observations are done for the real price movements that is, the highest price value was in 2015 (CFAF 791.05) and the lowest in 2006 (CFAF 592.69). According to the regression model, the obtained trend equations are **Y=798.04+21.91*X** for current price and **Y=712.38+4.14*X** for real price.

Table 4.14. Changes in Annual Consumer Prices of Black Nightshade (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	682.75	100.00	100.00	688.48	99.17
2006	584.33	85.59	85.59	710.39	82.26
2007	756.33	110.78	129.44	732.30	103.28
2008	804.42	117.82	106.36	754.21	106.66
2009	856.08	125.39	106.42	776.13	110.30
2010	960.42	140.67	112.19	798.04	120.35
2011	811.08	118.80	84.45	819.95	98.92
2012	706.67	103.50	87.13	841.86	83.94
2013	766.08	112.21	108.41	863.77	88.69
2014	878.67	128.70	114.70	885.68	99.21
2015	971.58	142.30	110.57	907.59	107.05

Source: (Author's calculation from data)

Table 4.15. Changes in Annual Consumer Prices of Black Nightshade (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	682.75	100.00	682.75	100.00	100.00	691.68	98.71
2006	584.33	98.59	592.69	86.81	86.81	695.82	85.18
2007	756.33	103.55	730.40	106.98	123.24	699.96	104.35
2008	804.42	109.00	737.99	108.09	101.04	704.10	104.81
2009	856.08	111.06	770.85	112.90	104.45	708.24	108.84
2010	960.42	112.68	852.34	124.84	110.57	712.38	119.65
2011	811.08	114.11	710.79	104.11	83.39	716.52	99.20
2012	706.67	117.15	603.23	88.35	84.87	720.66	83.70
2013	766.08	117.71	650.82	95.32	107.89	724.80	89.79
2014	878.67	123.19	713.26	104.47	109.59	728.94	97.85
2015	971.58	122.82	791.05	115.86	110.91	733.08	107.91

Source: (Author's calculation from data)

Coefficients of the independent variable X in the simple regression equations give the annual changes in dependent variables in both current and real prices that are 21.91 CFAF and 4.14 CFAF respectively. Thus, these values represent the annual price increases. For the same current and real prices during the research period, these annual prices increase on average 3.26% and 1.35% respectively. From 2005 to 2015, the current and real prices of black nightshade increased for 42.30% (Table 4.14) and 74.78% (Table 4.15) respectively. In the cyclical movements, prices seem to alternate around annual average trend line every 4 years. As it is seen, current and real prices of this product increase and this reflects national supply and demand effects on black nightshade price, as this product is not imported.

4.2.2.2. Monthly Fluctuations in Black Nightshade Prices

Table 4.16. Monthly Fluctuations in Black Nightshade Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	758.45	-11	0.91	-10.04	748.41	94	17
February	737.82	-9	0.91	-8.22	729.60	91	30
March	790.73	-7	0.91	-6.39	784.34	98	16
April	788.64	-5	0.91	-4.56	784.07	98	17
May	818.64	-3	0.91	-2.74	815.90	102	23
June	798.91	-1	0.91	-0.91	798.00	100	17
July	820.27	1	0.91	0.91	821.19	103	18
August	826.91	3	0.91	2.74	829.65	104	27
September	774.45	5	0.91	4.56	779.02	98	19
October	814.55	7	0.91	6.39	820.94	103	17
November	775.00	9	0.91	8.22	783.22	98	9
December	872.09	11	0.91	10.04	882.13	111	24
Mean	798.04	0.00	0.91	0.00	798.04	100.00	

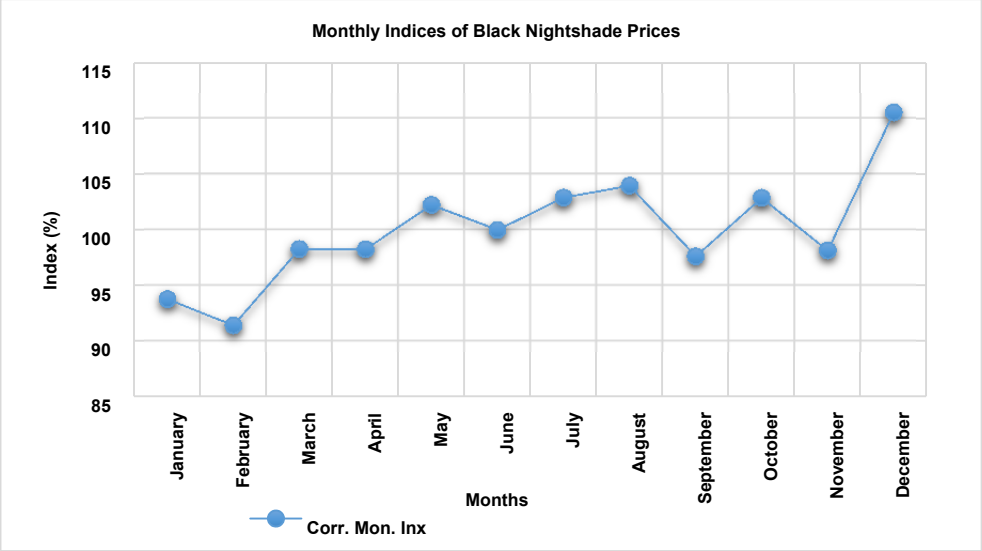

Figure 4.12. Monthly Indices of Black Nightshade Prices

The Table 4.16 presents the seasonal movements in black nightshade price. Over the years, black nightshade monthly prices were very unstable and as it is better seen in the Figure 4.12, the highest price occurs in December. During this month, price is 11% above the average annual price. In February, it is seen the lowest price with 9% below the average annual price. In the coefficient of variation column, monthly prices remain unstable and February presents the highest coefficient of variation. According to FAO (2018), this plant needs approximately 2 or 3 months to be harvested and the most preferable harvest time is from January (and February) and the price at this period is also the lowest of the year. These results are intended to inform consumers about the months of price fluctuations since they permit to know at what period it is preferable to buy this product. Black nightshade is a leafy vegetable, which is produced over the year.

4.2.3. Lettuce

Figure 4.13. Lettuce (*Lactuca Sativa*).

Lettuce (*Lactuca sativa*) is an annual plant of the daisy family, *asteraceae*. This plant is believed to have been domesticated in the Mediterranean region from the wild species *lactuca serriola L*. Lettuce grows best at 15°C to 18°C and is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce represents the second most valuable vegetable produced in the United States with farm-market receipts of over $1.98 billion in 2005. From 1980 to 2005, lettuce yield (hg/ha) increased by 118% compared to those of maize, potato, paddy rice and tomato. This might reflect the great importance of this crop in the world food consumption. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled. Lettuce is easily cultivated, although it requires relatively low temperatures to prevent it from flowering quickly (Still, 2007).

4.2.3.1. Trend Analysis for Lettuce

Table 4.17. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	-0.098	0.548	0.633	0.169	0.669	0.725
F	0.108	7.057	6.752***	3.035	11.124***	9.795***
Std. Err.	218.901	140.484	126.539	218.993	138.132	125.947
D-W	0.474	0.985	0.887	0.481	1.024	0.913
Cons.	1328.735***	1150.237***	1074.309***	1198.166***	1017.848***	945.480***
X	-6.859	-6.859	-6.859	-36.375	-36.375**	-36.375**
X^2	-	17.850***	44.214**	-	18.032***	43.160**
X^3	-	-	-1.055	-	-	-1.005

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

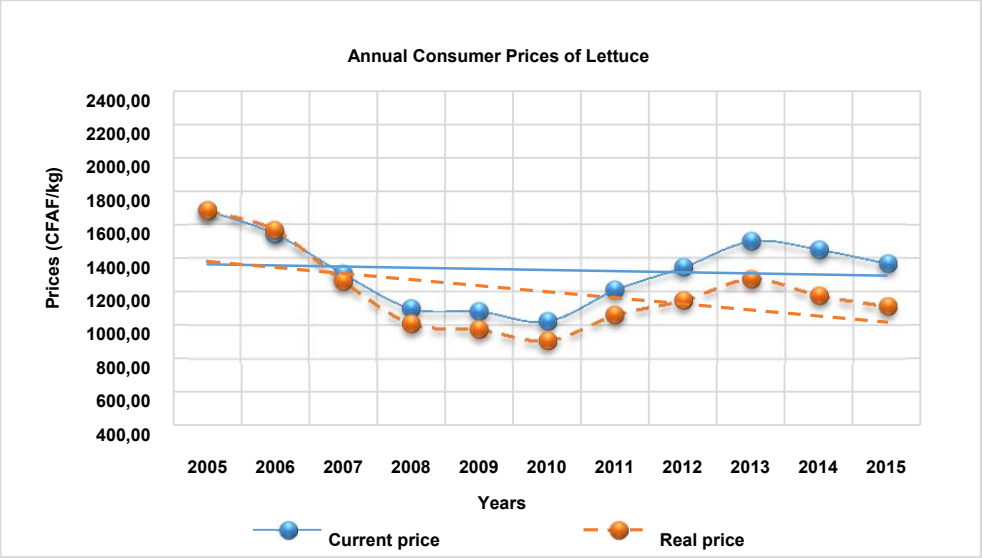

Figure 4.14. Annual Consumer Prices of Lettuce
Source: (IGAD data, Libreville's consumer prices, 2016)

The figure 4.14 presents the movements of lettuce annual current and real (constant) prices. Trend line equations are **Y=1328.74-6.86*X** for the current price and **Y=1198.17-36.38*X** for the real price. For these prices, it is noted in the current prices the highest value in 2005 (CFAF 1683.00) and the lowest value in 2010 (CFAF 1024.42). The real price presents its highest price in 2005 (CFAF 1683.00) and his lowest in 2010 (CFAF 909.14). Lettuce prices dropped during the study period and tended to present a specific cyclical movement that permits alternation around the price trend. The details concerning this cyclical movement and the general price variations are presented in the following tables.

Table 4.18. Changes in Annual Consumer Prices of Lettuce (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	1683.00	100.00	100.00	1363.04	123.47
2006	1543.33	91.70	91.70	1356.18	113.80
2007	1306.50	77.63	84.65	1349.32	96.83
2008	1100.50	65.39	84.23	1342.46	81.98
2009	1083.50	64.38	98.46	1335.60	81.12
2010	1024.42	60.87	94.55	1328.75	77.10
2011	1211.92	72.01	118.30	1321.89	91.68
2012	1345.92	79.97	111.06	1315.03	102.35
2013	1500.75	89.17	111.50	1308.17	114.72
2014	1449.42	86.12	96.58	1301.31	111.38
2015	1366.83	81.21	94.30	1294.45	105.59

Source: (Author's calculation from data)

Table 4.19. Changes in Annual Consumer Prices of Lettuce (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	1683.00	100.00	1683.00	100.00	100.00	1380.03	121.95
2006	1543.33	98.59	1565.40	93.01	93.01	1343.65	116.50
2007	1306.50	103.55	1261.70	74.97	80.60	1307.28	96.51
2008	1100.50	109.00	1009.62	59.99	80.02	1270.90	79.44
2009	1083.50	111.06	975.62	57.97	96.63	1234.53	79.03
2010	1024.42	112.68	909.14	54.02	93.19	1198.15	75.88
2011	1211.92	114.11	1062.06	63.11	116.82	1161.78	91.42
2012	1345.92	117.15	1148.91	68.27	108.18	1125.40	102.09
2013	1500.75	117.71	1274.96	75.75	110.97	1089.03	117.07
2014	1449.42	123.19	1176.56	69.91	92.28	1052.65	111.77
2015	1366.83	122.82	1112.86	66.12	94.59	1016.28	109.50

Source: (Author's calculation from data)

The Table 4.18 shows details about this product regarding its current price variations. Thus, in the general price changes from 2005 to 2015, the rate is -18.79% while in the Table 4.19, there are changes of the real price compared to the base year (2005) that are -33.88%. These data show prices of this crop in decrease and mostly in real terms. In trend line equations, the values of the price decrease each year are -6.86 CFAF and -36.38 CFAF for current and real prices respectively. During the research period, annual current and real lettuce prices increased on average -1.87% and -3.69% respectively; cyclical price movements were approximately observed every five years.

4.2.3.2. Monthly Fluctuations in Lettuce Prices

Table 4.20. Monthly Fluctuations in Lettuce Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	1443.45	-11	-0.29	3.14	1446.60	109	32
February	1344.18	-9	-0.29	2.57	1346.75	101	25
March	1360.45	-7	-0.29	2.00	1362.46	103	22
April	1415.18	-5	-0.29	1.43	1416.61	107	17
May	1434.82	-3	-0.29	0.86	1435.68	108	14
June	1314.27	-1	-0.29	0.29	1314.56	99	22
July	1148.18	1	-0.29	-0.29	1147.90	86	24
August	1031.64	3	-0.29	-0.86	1030.78	78	20
September	1161.55	5	-0.29	-1.43	1160.12	87	13
October	1380.91	7	-0.29	-2.00	1378.91	104	16
November	1431.82	9	-0.29	-2.57	1429.25	108	19
December	1478.36	11	-0.29	-3.14	1475.22	111	23
Mean	1328.73	0.00	-0.29	0.00	1328.73	100.00	

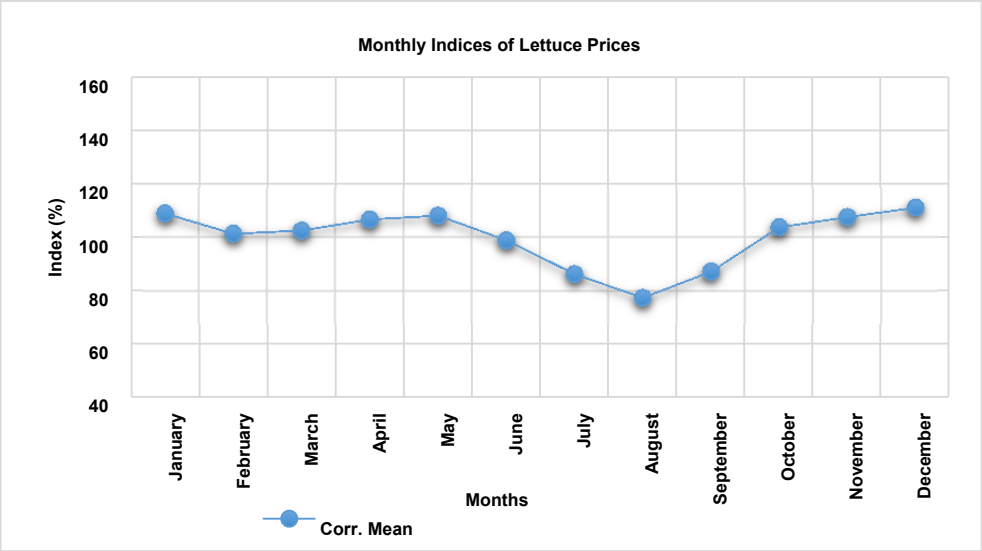

Figure 4.15. Monthly Indices of Lettuce Prices

The Table 4.20 presents lettuce seasonal price variations. The highest price is observed in December, which is 11% higher than annual mean price. The lowest percentage change in price is recorded in August, which is 22% below mean annual price. From June to September, prices are relatively lower perhaps because of the summer vacation period, Libreville being a little empty and this can affect the demand of this product on the market. In Gabon, this product is only used to do salads and according to a research from FAO (2018), this culture is harvested each two months. During the year, lettuce harvesting is mostly done during the summer period. Thus, as it can be seen on the Figure 4.15, at this period supply seems high and demand low, this may lead to price decreases and may contributes consequently to obtain the low prices observed during this period. The highest value of the coefficient of monthly price variations over the study period was registered in January, and the lowest in September.

4.2.4. Roselle

Figure 4.16. (a & b), Roselle (*Hibiscus Sabdariffa*).

Roselle (*Hibiscus sabdariffa*) is a vegetable that belongs to the family of *malvaceae* and is originated from West Africa. It is commonly available in the

tropics especially in the African countries. Roselle is an annual plant and requires around six months in its production cycle. In the tropical areas, warm and humid climate is suitable for roselle production. The temperatures between 18 and 35ºC with an optimum of 25°C present the best results to grow this crop and Sudan produces the best quality in the world. Roselle is a major contributor to medicine and nutrition with its high vitamin C and anthocyanin contents. The calcium, iron, niacin and riboflavin can be also found in roselle. The plant is also a source of antioxidants, which acts as free radical scavengers and inhibit lipid peroxidation. In the traditional medicine, roselle is used for the remedy of diuretic, mild laxative, cancer, cardiac and nerve diseases. All parts of this crop are utilized including leaves, fruits, roots and seeds in various foods. Its fleshy calyces and leaves contribute for making salads, tea, juices, jams, jellies, ice cream, and many other products (Aminul Islam et al, 2016).

4.2.2.1. Trend Analysis for Roselle

Table 4.21. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.86	0.84	0.841	0.388	0.331	0.266
F	62.540***	28.048***	18.587***	7.352**	3.475*	2.207
Std. Err.	40.032	42.293	42.74	35.319	36.938	38.699
D-W	3.181	3.18	3.231	2.914	2.953	2.923
Cons.	895.637***	892.001***	905.846***	799.109***	793.081***	800.453***
X	30.185***	30.185***	30.185***	9.131**	9.131**	9.131**
X^2	-	0.364	-4.443	-	0.603	-1.957
X^3	-	-	0.193	-	-	0.102

Where: *** ($p<0.01$); ** ($p<0.05$); * ($p<0.10$)

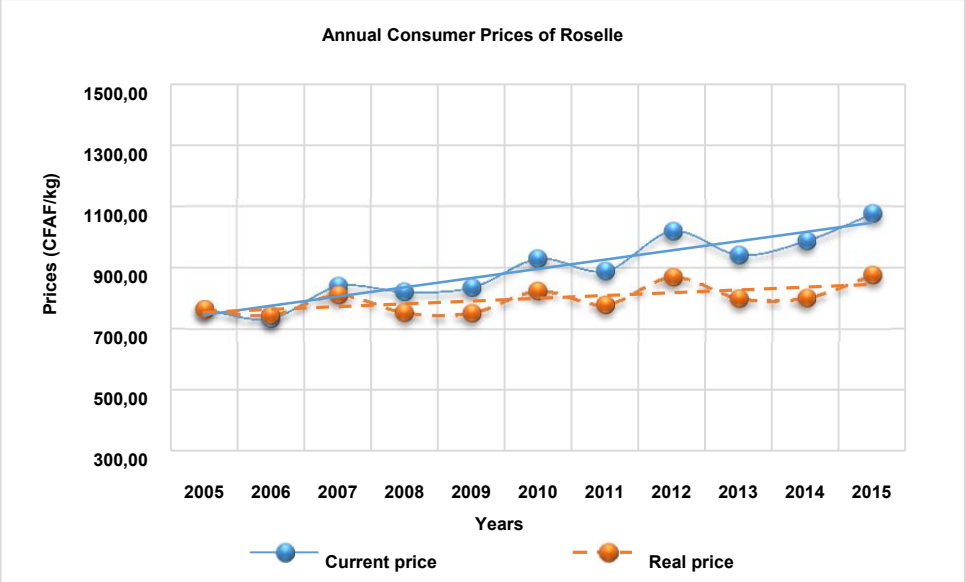

Figure 4.17. Annual Consumer Prices of Roselle
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 4.17 presents the evolution of roselle annual current and real (constant) price movements. During the study period, roselle prices evolved with several fluctuations and in increasing trend. With the regression model, the trend line equations obtained gave, concerning the current price, **Y=895.64+30.19*X** and for the real price, **Y=799.11+9.13*X.** The instability is observed in price evolution but there are no big differences between values reached by the peaks around the trend line. On these price evolutions, the lowest price for current price is registered in 2006 (CFAF 735.92) and the highest in 2015 (CFAF 1077.50). For the real price, the years are the same for those of current price with values of CFAF 746.44 for the lowest price and CFAF 877.28 for the highest price.

Table 4.22. Changes in Annual Consumer Prices of Roselle (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	766.08	100.00	100.00	744.72	102.87
2006	735.92	96.06	96.06	774.90	94.97
2007	841.17	109.80	114.30	805.09	104.48
2008	822.75	107.40	97.81	835.27	98.50
2009	836.50	109.19	101.67	865.46	96.65
2010	930.33	121.44	111.22	895.64	103.87
2011	890.67	116.26	95.74	925.83	96.20
2012	1019.92	133.13	114.51	956.01	106.68
2013	942.75	123.06	92.43	986.20	95.59
2014	988.42	129.02	104.84	1016.38	97.25
2015	1077.50	140.65	109.01	1046.57	102.96

Source: (Author's calculation from data)

Table 4.23. Changes in Annual Consumer Prices of Roselle (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	766.08	100.00	766.08	100.00	100.00	753.46	101.68
2006	735.92	98.59	746.44	97.44	97.44	762.59	97.88
2007	841.17	103.55	812.32	106.04	108.83	771.72	105.26
2008	822.75	109.00	754.81	98.53	92.92	780.85	96.67
2009	836.50	111.06	753.21	98.32	99.79	789.98	95.35
2010	930.33	112.68	825.64	107.77	109.62	799.11	103.32
2011	890.67	114.11	780.53	101.89	94.54	808.24	96.57
2012	1019.92	117.15	870.63	113.65	111.54	817.37	106.52
2013	942.75	117.71	800.91	104.55	91.99	826.50	96.90
2014	988.42	123.19	802.35	104.73	100.18	835.63	96.02
2015	1077.50	122.82	877.28	114.52	109.34	844.76	103.85

Source: (Author's calculation from data)

The trend line equations from simple regression model concerning this crop gives the values of annual price changes that are 30.19 CFAF and 9.13 CFAF for current and real prices respectively. It also shows increases in current price at the rate 40.65% (Table 4.22) compared to the base year (2005) while this rate represents 14.52% (Table 4.23) for the real price. During the research period annual, current and constant prices of roselle increased on average 3.15% and 1.24% respectively. Prices over the years are not linear and increase rapidly, approximately each year they alternate around trend lines, this movement represents the cyclical component.

4.2.2.2. Monthly Fluctuations in Roselle Prices

Table 4.24. Monthly Fluctuations in Roselle Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	836.09	-11	1.26	-13.83	822.26	92	17
February	798.09	-9	1.26	-11.32	786.77	88	13
March	804.45	-7	1.26	-8.80	795.65	89	16
April	810.64	-5	1.26	-6.29	804.35	90	15
May	828.36	-3	1.26	-3.77	824.59	92	22
June	915.82	-1	1.26	-1.26	914.56	102	20
July	995.91	1	1.26	1.26	997.17	111	17
August	1032.64	3	1.26	3.77	1036.41	116	22
Septembei	961.64	5	1.26	6.29	967.92	108	25
October	934.82	7	1.26	8.80	943.62	105	12
November	908.18	9	1.26	11.32	919.50	103	15
December	921.00	11	1.26	13.83	934.83	104	11
Mean	895.64	0.00	1.26	0.00	895.64	100.00	

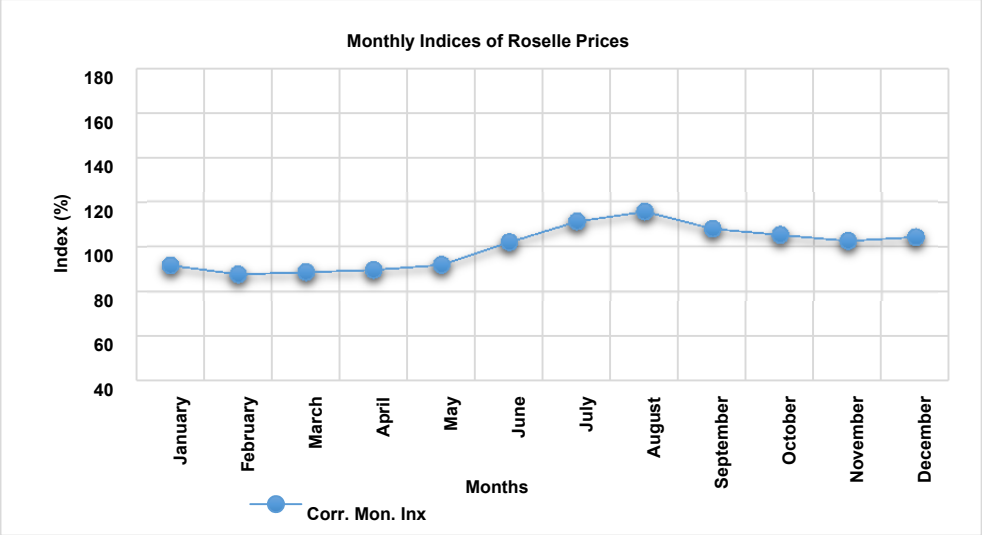

Figure 4.18. Monthly Indices of Roselle Prices.

The Table 4.24 shows monthly price variations of roselle. During the years, monthly prices present higher values in August and are 16 % above the annual average price. Lower price values are registered in February. In this month, prices are 12% below the annual average price. In the coefficient of variation column, September presents high price variations over the study period. In a research from FAO (2018), harvests of this product in Gabon are mostly done from October to May period. The prices of roselle confirmed this reality since they decreased during these harvest seasons.

During the summer holiday periods, the prices of some vegetables namely roselle, (Figure 4.18) were strongly disturbed. In most cases, prices returned to their normal rhythms once the holidays were over. These signs may show the link between the prices of certain products and some specific periods of the year. Due to such price movements during some specific periods, prices may seriously harm consumers and affect access to food.

The production of Leafy Vegetable Groups (Aromatic Leafy Vegetables and Leafy Vegetables) increased in general by 30% during the study period. This

increase is exclusively originated from the enlargement of their cultivated areas, while the yield decreased by 10%, according to the statistics from FAO (2018). Even though the increase of production contributed to the price decrease at some periods and for some cultures, the price of the majority of products still increased during the study period. In this case, the increasing supply does not satisfy the demand.

4.3. Vegetable-Fruits

4.3.1. Pepper

Figure 4.19. Pepper (*Capsicum Annuum*).

Capsicum annuum, commonly known as pepper, is a fruit vegetable crop. It is a member of the s*olanaceae* family, and is native from the Americas. Pepper is a warm season crop. However, extreme temperature effects in germination, growth, and fruit set can be unfavorable. Available in various colors, shapes, sizes, and pungency, pepper is a well-known spice and condiment worldwide. It also has relatively high amounts of vitamin B6, and its fresh fruit is made up of 94% of water. Dried pepper fruit has a much different nutritional value due to the dehydration and concentration of vitamins and minerals. There is also an interest in *capsicum* pepper because of its high antioxidant constituents, like vitamins C, and

A, phenolic acids, flavonoids and vitamin B6. Pepper contains more than 100% of the daily-recommended value for vitamin C, and also more as compared to an orange. *Capsicum* can be eaten raw or cooked and the most used are c*apsicum annuum* and c*apsicum frutescens* species, though a few others are used (Sinha et al, 2011).

4.3.1.1. Trend Analysis for Pepper

Table 4.25. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.392	0.856	0.862	0.191	0.804	0.805
F	7.457**	30.787***	21.881***	3.367*	21.472***	14.758***
Std. Err.	940.534	457.426	447.663	851.672	419.626	418.273
D-W	0.756	2.864	2.767	0.803	2.99	2.89
Cons.	4316.484***	5172.528***	5357.253***	3823.456***	4595.899***	4748.096***
X	244.880**	244.880***	244.880***	149.012*	149.012***	149.012***
X2	-	-85.604***	-149.745**	-	-77.244***	-130.090**
X3	-	-	2.566	-	-	2.114

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

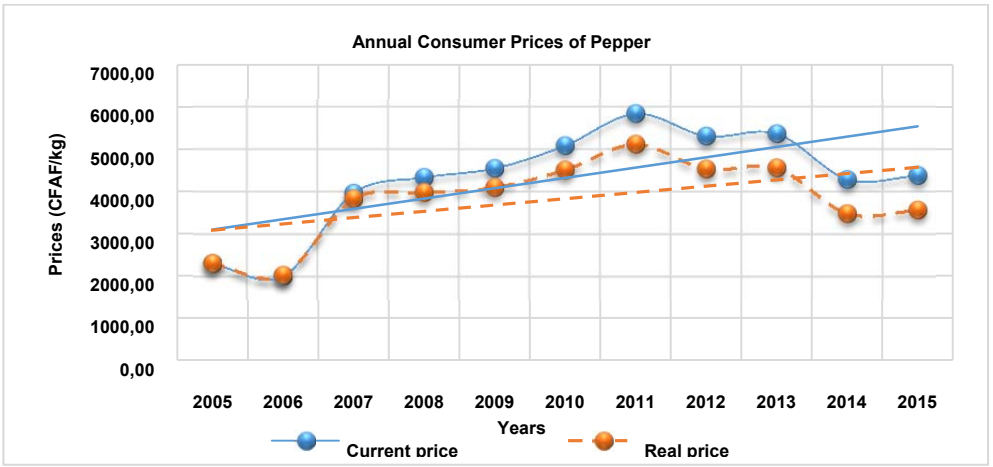

Figure 4.20. Annual Consumer Prices of Pepper
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 4.20 shows annual changes of pepper current and real prices over the study period. The regression model produces the trend line equations as follows: **Y=4316.48+244.88*X** for the current price and **Y=3823.46+149.01*X** for the real price. The lowest price is recorded in 2006 (CFAF 2008.33) and the highest in 2011 (CFAF 5843.33) for current prices. For the real prices, the lowest value is recorded in 2006 (CFAF 2037.05) and the highest in 2011 (5120.80). The prices over the period starting from 2007 to 2013 are higher than those of the rest of the study period. Pepper at its stage of production is sensible to many pathologies as well as climatic factors. Therefore, the use of an appropriate equipment is very important. With the recurrent problem of investment sources in the agricultural sector in Gabon, the activities related to produce this crop are generally a little hard. Besides this problem, the product is subject to a high import mainly from Cameroon. Indeed, according to IGAD yearly reports, the origin of pepper sales in the year 2007 at Libreville located the local production at 54% and Cameroon imports at 46%. In 2010, local production represented 60% and Cameroon imports 40%. These strong import percentages from Cameroon combined with local problems may highly contribute to the observed sharp fluctuation and price increases.

Table 4.26. Changes in Annual Consumer Prices of Pepper (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	2313.33	100.00	100.00	3092.08	74.81
2006	2008.33	86.82	86.82	3336.96	60.18
2007	3970.08	171.62	197.68	3581.84	110.84
2008	4340.42	187.63	109.33	3826.72	113.42
2009	4553.58	196.84	104.91	4071.60	111.84
2010	5089.25	220.00	111.76	4316.48	117.90
2011	5843.33	252.59	114.82	4561.36	128.11
2012	5314.00	229.71	90.94	4806.24	110.56
2013	5371.00	232.18	101.07	5051.12	106.33
2014	4292.92	185.57	79.93	5296.00	81.06
2015	4385.08	189.56	102.15	5540.88	79.14

Source: (Author's calculation from data)

Table 4.27. Changes in Annual Consumer Prices of Pepper (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	2313.33	100.00	2313.33	100.00	100.00	3078.41	75.15
2006	2008.33	98.59	2037.05	88.06	88.06	3227.42	63.12
2007	3970.08	103.55	3833.96	165.73	188.21	3376.44	113.55
2008	4340.42	109.00	3982.00	172.13	103.86	3525.45	112.95
2009	4553.58	111.06	4100.21	177.24	102.97	3674.46	111.59
2010	5089.25	112.68	4516.56	195.24	110.15	3823.47	118.13
2011	5843.33	114.11	5120.80	221.36	113.38	3972.48	128.91
2012	5314.00	117.15	4536.16	196.09	88.58	4121.50	110.06
2013	5371.00	117.71	4562.91	197.24	100.59	4270.51	106.85
2014	4292.92	123.19	3484.77	150.64	76.37	4419.52	78.85
2015	4385.08	122.82	3570.27	154.33	102.45	4568.53	78.15

Source: (Author's calculation from data)

The Table 4.26 presents the behavior of pepper current consumer price. Price changes in 2015 compared to that of 2005 show an increase of 89.56%. The real price at the same date compared to that of the base year's price (2005) presents an increase of 54.33% (Table 4.27). From 2005 to 2015, all prices seemed alternate around their trend lines every seven years approximately (cyclical component). According to the regression model, annual changes in current and real prices presented increases of 244.88 CFAF and 149.01 CFAF in current and real terms respectively. During the research period, annual current and real pepper prices are also increased on average 5.99% and 4.02% respectively.

4.3.1.2. Monthly Fluctuations in Pepper Prices

Table 4.28. Monthly Fluctuations in Pepper Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	3792.45	-11	10.20	-112.24	3680.22	85	27
February	3787.18	-9	10.20	-91.83	3695.35	86	34
March	3804.91	-7	10.20	-71.42	3733.49	86	39
April	4039.36	-5	10.20	-51.02	3988.35	92	38
May	4534.82	-3	10.20	-30.61	4504.21	104	39
June	4621.18	-1	10.20	-10.20	4610.98	107	34
July	4723.55	1	10.20	10.20	4733.75	110	30
August	4655.91	3	10.20	30.61	4686.52	109	33
September	4520.09	5	10.20	51.02	4571.11	106	30
October	4488.00	7	10.20	71.42	4559.42	106	22
November	4327.18	9	10.20	91.83	4419.01	102	29
December	4503.18	11	10.20	112.24	4615.42	107	19
Mean	4316.48	0.00	10.20	0.00	4316.48	100.00	

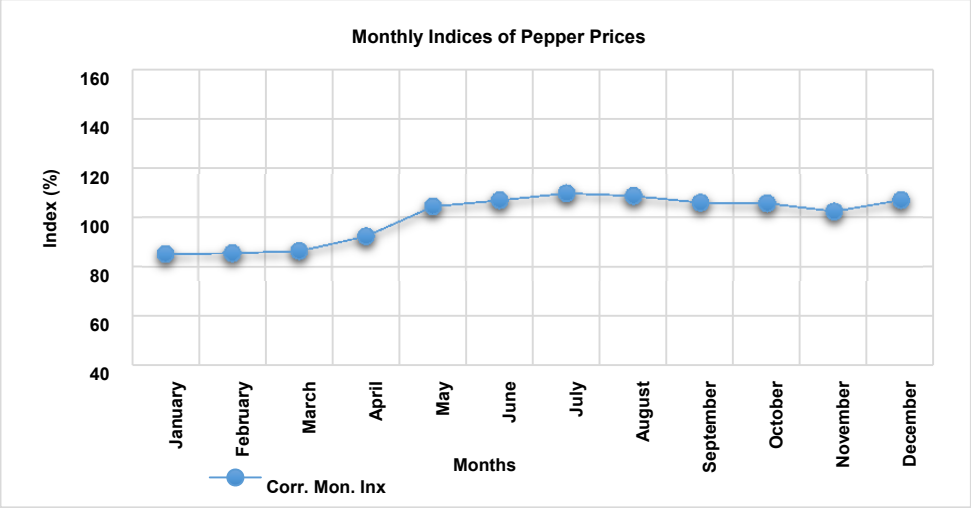

Figure 4.21. Monthly Indices of Pepper Prices.

The Table 4.28 shows the pepper monthly price variations. Over the years concerned by the study, July presents the highest price value that is at 10% above the annual average price. Lower prices are recorded in January, February and March, with 15%, 14% and 14% below the annual average price respectively. The coefficient of variation is also high in March and May. During these months, prices fluctuate more than it does during the other months. Pepper is a dry season crop. Concerning its price variations, the highest values are mainly recorded from May to August since this period represents the planting time as presented in the data from FAO (2018). From September until November, the prices start a small decrease because the harvest is also starting. However, the harvest of pepper in Gabon is preferably done between the months of December and January according to the FAO data again in 2018. These facts may help to justify why prices are generally low from January to March as shown in the Figure 4.21.

4.3.2. Tomato

Figure 4.22. Tomato (*Lycopersicon Esculentum L*).

Lycopersicum esculentum L, commonly known as tomato, is an edible, often red, fruit/berry of the plant. This plant is both qualitatively and quantitatively a worldwide important vegetable, with an annual estimated production of 88

million tons. Tomato is a fruit vegetable originated from the Andes of South America. It belongs to the nightshade family, s*olanaceae,* and prefers warm temperatures for its production. Required temperatures for this culture are ranged between 25°C to 30°C. Tomatoes are consumed in diverse forms including raw as an ingredient in many dishes, sauces, salads, and drinks. However, the major percentage of tomatoes are used for processed products such as juice, paste, puree, soup, ketchup, sauce, and as canned tomatoes. Tomato is a perennial vegetable in its native habitat, but it is cultivated as an annual (Sinha et al, 2011).

4.3.2.1. Trend Analysis for Tomato

Table 4.29. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.694	0.813	0.804	0.12	0.359	0.497
F	23.695***	17.393***	14.705***	2.368	3.803*	4.291*
Std. Err.	75.311	65.834	60.231	71.295	60.849	53.922
D-W	1.119	1.565	2.111	0.953	1.387	1.936
Cons.	1009.250***	965.566***	931.392***	900.700***	857.347***	823.192***
X	34.953***	34.953***	34.953***	10.461	10.461	10.461*
X^2	-	4.4368*	16.234*	-	4.335*	16.195*
X^3	-	-	-0.475	-	-	-0.474

Where: *** ($p<0.01$); ** ($p<0.05$); * ($p<0.10$)

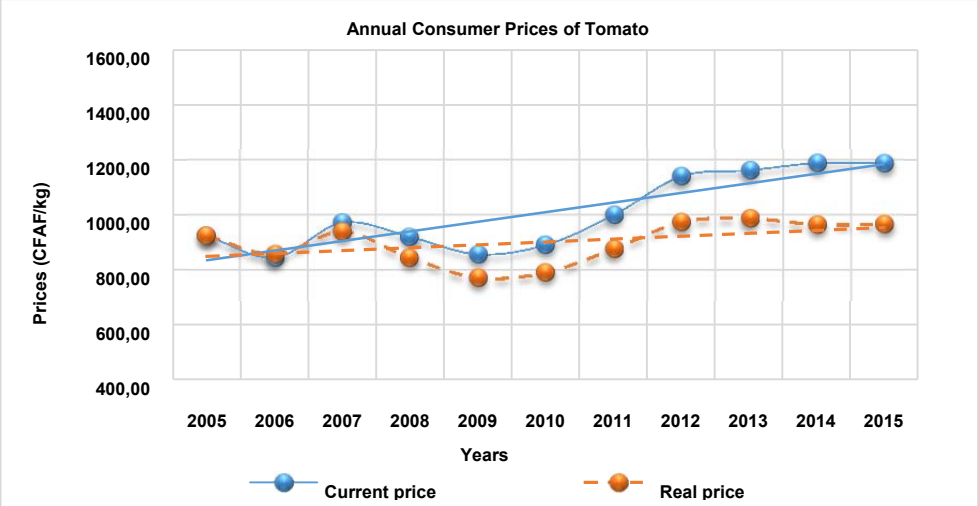

Figure 4.23. Annual Consumer Prices of Tomato
Source: (IGAD data, Libreville's consumer prices, 2016)

The Figure 0.23 presents tomato annual current and real (constant) prices. In order to estimate future prices (Y) of tomato, the results of the regression model give the following trend line equations **Y=1009.25+34.95*X** for the current price and **Y=900.7+10.46*X** for the real price. Concerning the current price, the highest value is obtained in 2014 (CFAF 1189.92) and the lowest in 2006 (CFAF 846.25). Regarding the real prices, the highest value is obtained in 2013 (CFAF 988.38) and the lowest in 2009 (CFAF 772.50). At the Libreville market, annual prices of this product present an instability that usually characterizes the agricultural product prices. Generally, this crop necessitates a high technical level and a consequent equipment for its production. In the majority of cases in Gabon, farmers who produce tomato every time and every season need large investments to better control their production cycles without worrying about climatic disturbances and diseases.

Table 4.30. Changes in Annual Consumer Prices of Tomato (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	925.33	100.00	100.00	834.48	110.89
2006	846.25	91.45	91.45	869.44	97.33
2007	973.58	105.21	115.05	904.39	107.65
2008	921.08	99.54	94.61	939.34	98.06
2009	857.92	92.71	93.14	974.30	88.06
2010	892.33	96.43	104.01	1009.25	88.42
2011	1001.42	108.22	112.22	1044.20	95.90
2012	1142.17	123.43	114.06	1079.15	105.84
2013	1163.42	125.73	101.86	1114.11	104.43
2014	1189.92	128.59	102.28	1149.06	103.56
2015	1188.33	128.42	99.87	1184.01	100.36

Source: (Author's calculation from data)

Table 4.31. Changes in Annual Consumer Prices of Tomato (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	925.33	100.00	925.33	100.00	100.00	848.39	109.07
2006	846.25	98.59	858.35	92.76	92.76	858.85	99.94
2007	973.58	103.55	940.20	101.61	109.54	869.31	108.15
2008	921.08	109.00	845.02	91.32	89.88	879.77	96.05
2009	857.92	111.06	772.50	83.48	91.42	890.24	86.77
2010	892.33	112.68	791.92	85.58	102.51	900.70	87.92
2011	1001.42	114.11	877.59	94.84	110.82	911.16	96.32
2012	1142.17	117.15	974.98	105.37	111.10	921.62	105.79
2013	1163.42	117.71	988.38	106.81	101.37	932.08	106.04
2014	1189.92	123.19	965.91	104.39	97.73	942.54	102.48
2015	1188.33	122.82	967.52	104.56	100.17	953.00	101.52

Source: (Author's calculation from data)

The result of the regression concerning this crop shows that, the coefficients of X (annual price values of increase or decrease) are 34.95 CFAF and 10.46 CFAF for current and real prices respectively. Annual averages of these prices also presented increase of 2.3%, 0.41% respectively. Then, during the study

period, current and real price changes compared to the base year 2005 were 28.42% (Table 4.30) and 4.56% (Table 4.31) respectively. The price of tomato increased over the study period and seemed to alternate around the trend line every 4 years (cyclical component). However, tomato production increased by 9% from 2005 to 2015. This increase may totally imputed to the development of the tomato cultivated area, whereas yield presented a decrease of 0.2% according to the data from FAO (2018). Thus, despite the increases of the tomato production and its importation, prices continued to increase and mostly in current term since the change in real term was just very close to zero each year during the study period.

4.3.2.2. Monthly Fluctuations in Tomato Prices

Table 4.32. Monthly Fluctuations in Tomato Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	1014.45	-11	1.55	-17.06	997.39	99	20
February	980.09	-9	1.55	-13.96	966.13	96	19
March	1027.09	-7	1.55	-10.86	1016.23	101	25
April	1029.27	-5	1.55	-7.76	1021.52	101	20
May	993.73	-3	1.55	-4.65	989.07	98	19
June	1029.09	-1	1.55	-1.55	1027.54	102	13
July	1009.36	1	1.55	1.55	1010.91	100	16
August	1041.91	3	1.55	4.65	1046.56	104	20
September	1019.64	5	1.55	7.76	1027.39	102	13
October	950.27	7	1.55	10.86	961.13	95	18
November	972.09	9	1.55	13.96	986.05	98	20
December	1044.00	11	1.55	17.06	1061.06	105	18
Mean	1009.25	0.00	1.55	0.00	1009.25	100.00	

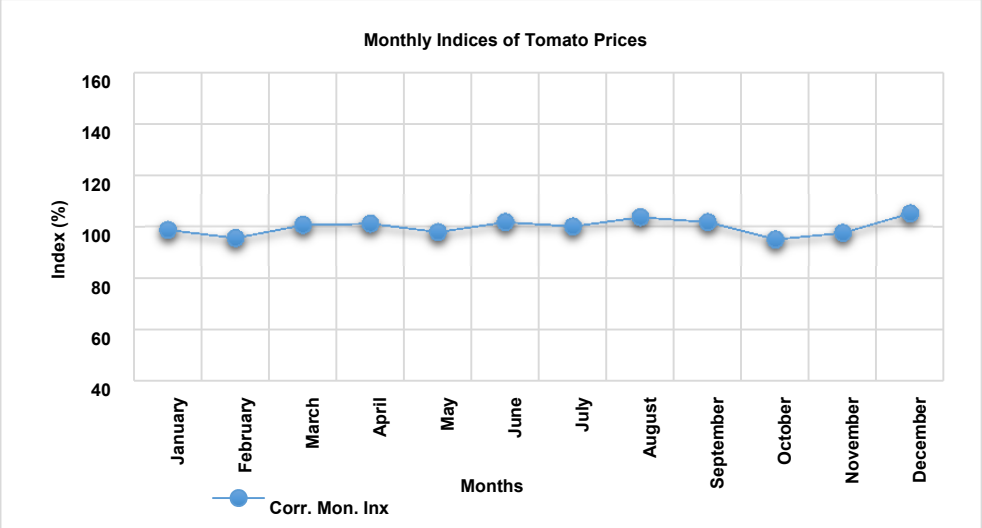

Figure 4.24. Monthly Indices of Tomato Prices.

The Table 4.32 shows tomato monthly price variations. The price variations illustrate that the month of October, with 5% below the annual average price, registered the lowest value of the year. On the other hand, price is higher in December. The price of this month is 5% above the annual average price. In the coefficient of variation column, March is the month with the highest coefficient of price variation. According to FAO statistics (2018), the tomato production cycle needs at least three months. During the harvest, the price of the tomato decreases. Thus, this fact reflects the effects of supply on demand due to harvesting. However, the lowest price is observed in October. This may be due to the fact that the harvest is mostly done at this time of the year and consequently, allows its better offer on the market. During its reports, IGAD mentions that this product is highly imported at Libreville market but since data were not consequent (import quantities were not regularly monitored), over the years, they were not reported in the present work. However, these import quantities may explain the relative constant price around the average annual prices over the year shown in the Figure 4.24.

4.3.3. White Eggplant

Figure 4.25. White Eggplant (*Solanum Melongena*).

Eggplant or aubergine (*Solanum melongena* L.) alongside with tomato and pepper is among the most widely known edible fruits of the s*olanaceae* family. Eggplant is to be derived from the wild African species, *solanum incanum*, is grown and consumed in Africa and other parts over the world. In 2014, the world-cultivated area of eggplant was 1.8 million ha, and its production was 46.6 million tons. In 2012, export of eggplant in the frame of world trade has shown a growing trend that reached 440,000 tons. Eggplant requires 60 to 85 days to complete the cultural cycle. This culture is a warm season crop that relatively needs high temperatures with an optimum around 23°C to 26°C. The crop grows during the summer season and appears sensitive to cool weather. This crop also presents bad performances when it is exposed to low temperatures. Eggplant is used in many countries' cuisines (Zaro et al, 2015).

4.3.3.1. Trend Analysis for White Eggplant

Table 4.33. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.667	0.636	0.64	0.371	0.303	0.304
F	21.075***	9.727***	6.913**	6.902**	3.178*	2.454
Std. Err.	90.064	94.295	93.81	81.705	85.992	85.971
D-W	1.385	1.437	1.536	1.335	1.368	1.452
Cons.	761.003***	775.964***	810.599***	676.075***	686.460***	717.020***
X	39.435***	39.435***	39.435***	20.466**	20.466**	20.466**
X^2	-	-1.496	-13.522	-	-1.038	-11.65
X^3	-	-	0.481	-	-	0.424

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

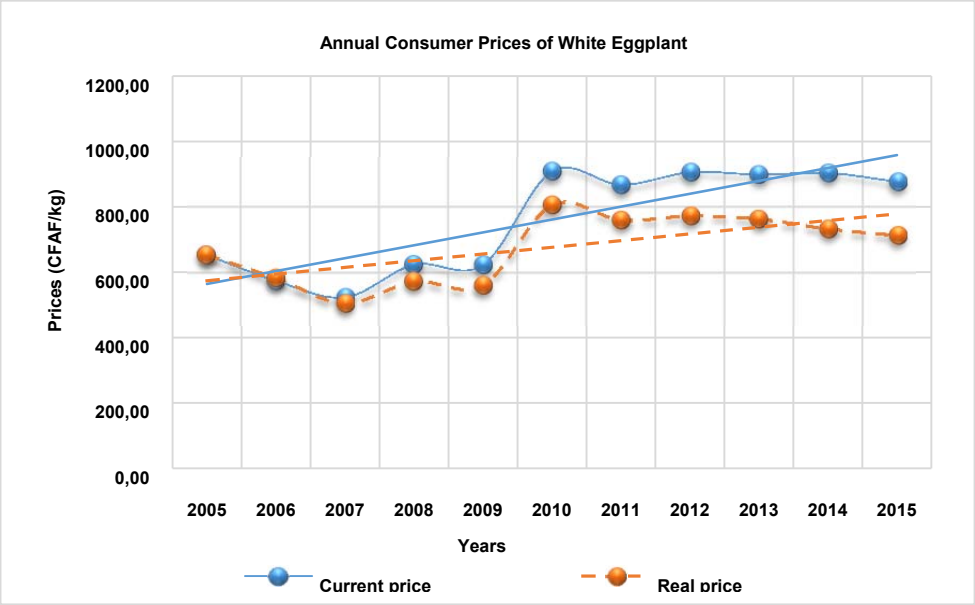

Figure 4.26. Annual Consumer Prices of White Eggplant
Source: (IGAD data, Libreville's consumer prices, 2016)

Figure 4.26 presents the white eggplant's annual current and real (constant) prices. The price evolutions illustrate an instability and a rise of prices over the study period. The obtained trend line equations are **Y=761+39.44*X** for the current price and **Y=676.08+20.47*X** for the real price. As far as the current price is concerned, the lowest value is registered in 2007 (CFAF 526.20) and the highest in 2010 (CFAF 908.92). For the real price, the lowest price is in 2007 (CFAF 508.16) and the highest is in 2010 (CFAF 806.64). Despite the fact that this product is not imported at Libreville market, there are several price fluctuations and a sharp increase is observed; for instance the period from 2009 to 2015.

Table 4.34. Changes in Annual Consumer Prices of White Eggplant (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	654.92	100.00	100.00	563.83	116.16
2006	576.75	88.06	88.06	603.26	95.61
2007	526.20	80.35	91.24	642.70	81.87
2008	626.00	95.58	118.97	682.13	91.77
2009	625.08	95.44	99.85	721.57	86.63
2010	908.92	138.78	145.41	761.00	119.44
2011	867.83	132.51	95.48	800.44	108.42
2012	906.00	138.34	104.40	839.87	107.87
2013	898.83	137.24	99.21	879.31	102.22
2014	903.67	137.98	100.54	918.74	98.36
2015	876.83	133.88	97.03	958.18	91.51

Source: (Author's calculation from data)

Table 4.35. Changes in Annual Consumer Prices of White Eggplant (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/ kg	2005=100	CFAF/ kg	2005=100			
2005	654.92	100.00	654.92	100.00	100.00	573.75	114.15
2006	576.75	98.59	585.00	89.32	89.32	594.21	98.45
2007	526.20	103.55	508.16	77.59	86.87	614.68	82.67
2008	626.00	109.00	574.31	87.69	113.02	635.15	90.42
2009	625.08	111.06	562.85	85.94	98.00	655.62	85.85
2010	908.92	112.68	806.64	123.17	143.31	676.08	119.31
2011	867.83	114.11	760.52	116.13	94.28	696.55	109.18
2012	906.00	117.15	773.38	118.09	101.69	717.02	107.86
2013	898.83	117.71	763.60	116.60	98.74	737.48	103.54
2014	903.67	123.19	733.55	112.01	96.06	757.95	96.78
2015	876.83	122.82	713.90	109.01	97.32	778.42	91.71

Source: (Author's calculation from data)

The Table 4.34 presents the details of white eggplant's current price changes from 2005 to 2015. During this period, the price considerably increased (33.88%). The value of the real price (Table 4.35), increases at a rate of 9.01% as compared to the one of the base year 2005. According to the regression model, annual price increases are CFAF 39.44 and CFAF 20.47 for current and real prices respectively. Thus, the current and real prices of white eggplant increased on average 2.69% and 0.79% respectively. These changes may be related to the low supply of this product on the market that seems not to satisfy the demand associated to many other factors. During the study period, white eggplant production increased by 67%. This increase is the result of the expansion of the white eggplant's cultivated area. However, the yield decreased for 0.1% (FAO, 2018). Finally, the prices continued to rise despite the increase of the production

during the study period. The cyclical price movements showed alternation of prices around the trend lines each four years approximately.

4.3.3.2. Monthly Fluctuations in White Eggplant Prices

Table 4.36. Monthly Fluctuations in White Eggplant Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correctior	Total Corr.	Corr. Mear (CFAF/kg)	Corr. Mon Inx (%)	CV (%)
January	700.27	-11	1.64	-18.07	682.20	89	27
February	676.36	-9	1.64	-14.79	661.58	86	23
March	694.27	-7	1.64	-11.50	682.77	89	29
April	730.45	-5	1.64	-8.22	722.24	94	19
May	790.45	-3	1.64	-4.93	785.53	103	25
June	763.82	-1	1.64	-1.64	762.18	100	15
July	887.27	1	1.64	1.64	888.92	116	19
August	846.55	3	1.64	4.93	851.47	111	17
September	859.45	5	1.64	8.22	867.67	113	36
October	760.91	7	1.64	11.50	772.41	101	30
November	713.18	9	1.64	14.79	727.97	95	28
December	757.09	11	1.64	18.07	775.17	101	27
Mean	765.01	0.00	1.64	0.00	765.01	100.00	

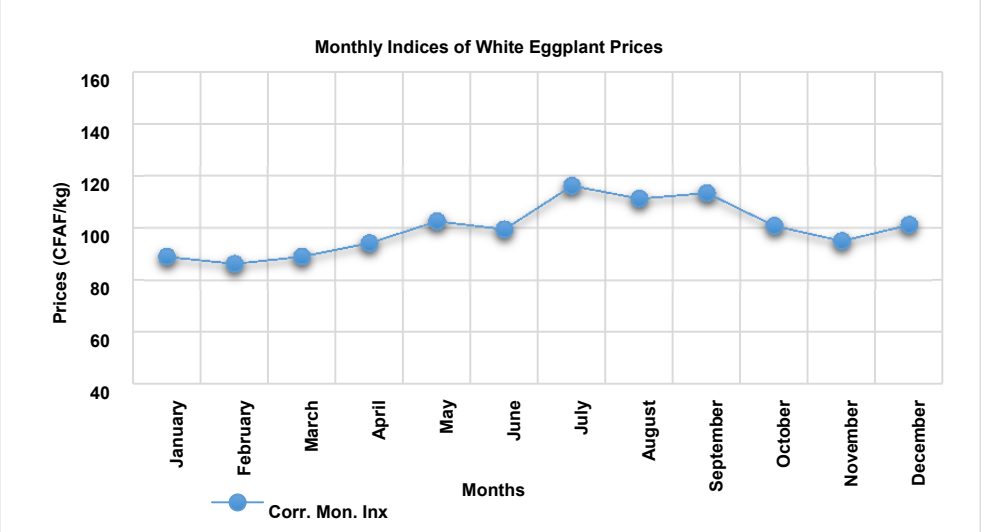

Figure 4.27. Monthly Indices of White Eggplant Prices.

The table 4.36 presents the white eggplant monthly price variations. The highest price is observed in July. That month, the price is 16% above the annual average price. The lowest price of this product is recorded in February. The price in February is 14% below the annual average price. All over the years concerned by this study, the price of this product fluctuated too much, and the month of September recorded the highest fluctuation as indicated in the coefficient of variation column. The period from May to September (dry season) shows higher prices in general and this observation is similar for all the products in this group of vegetable-fruits. According to the data from FAO (2018), this crop needs at least 4 months to be harvested. The same source mentions that harvest of this product is mostly done during March, October and December (FAO, 2018). On the figure 4.27, it is shown that at these periods of the year, the prices decrease significantly. The real causes of high prices (specific periods in which price are above the average annual price) were not determined in the present study and may then be a subject for further studies.

4.4. Staple Crops

In 2011, IGAD launched an Agricultural Development and Investment Project named PRODIAG. Government supplied only 20% of the funds and remaining 80% came from the French Development Agency (AFD). One of the aims of the project is commercialization of semi-urban agriculture. PRODIAG supported farms producing the high yielding crops such as amaranth, tomatoes, celery and lettuce. Plantain and cassava were among the most profitable products supported by PRODIAG project in Gabon. (Anonymous, 2016).

4.4.1. Cassava Tuber

Figure 4.28. Cassava Tuber (*Manihot Esculenta*).

Cassava (also known as manioc) is a major tuber crop cultivated in all the tropical countries. It is a crop that may adapt to marginal areas. Its flexible growth cycle facilitate its expansion worldwide, especially in the areas with high population pressure. In areas where land is scarce and population increase is high, farmers shift to crops such as cassava with higher energy output per unit land. Low income and rapid population growth make cassava a staple and food security crop. Africa produces more cassava than the rest of the world. It is reported that annual growth rate of cassava in Africa is almost the same as the population growth rate in Africa between 1965 and 1985. Nigeria is the largest producer in the world (Lebot, 2009).

4.4.1.1. Trend Analysis for Cassava Tuber

Table 4.37. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
R^2 adj	0.793	0.914	0.908	0.567	0.826	0.815
F	39.237***	54.245***	33.969***	14.104***	24.656***	15.645***
Std. Err.	39.303	25.291	26.157	35.1777	22.335	23.024
D-W	0.826	1.761	1.787	0.754	1.601	1.623
Cons.	401.834***	369.835***	363.410***	356.718***	327.858***	321.919***
X	23.473***	23.473***	23.473***	12.596***	12.596***	12.596***
X^2	-	3.200***	5.431	-	2.886***	4.948
X^3	-	-	-0.089	-	-	-0.082

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

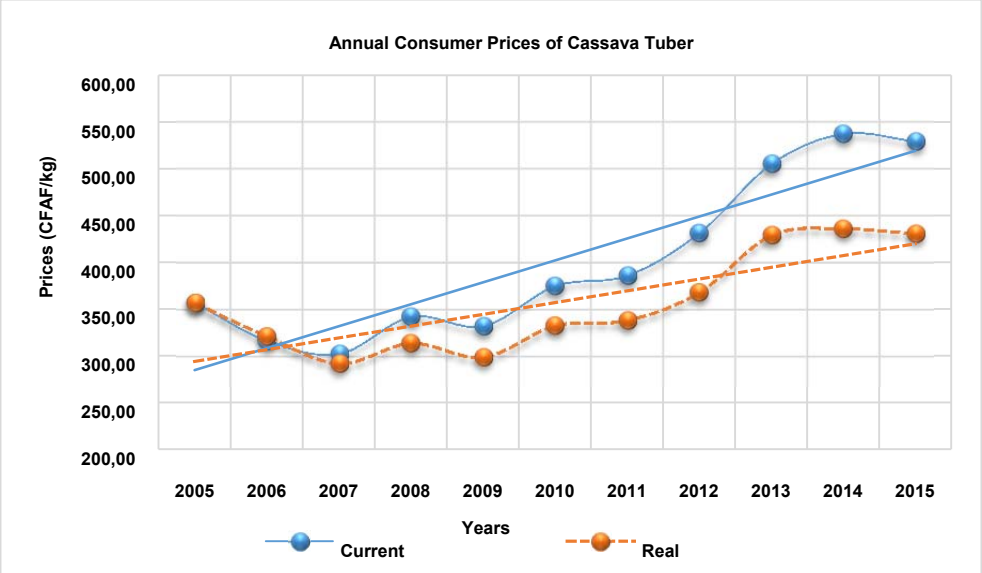

Figure 4.29. Annual Consumer Prices of Cassava Tuber
Source: (IGAD data, Libreville's consumer prices, 2016)

In Gabon, cassava is one of the most consumed products. Since cassava production does not require much material or a big financial investment, a very large part of Gabonese people produces it for many usages. Figure 4.29 presents changes in current and real prices of this product. The regression equations are, **Y=401.83+23.47*X,** for current price and **Y=356.72+12.60*X** for real price. The lowest and highest current values were observed in 2007 (CFAF 303.17) and in 2014 (CFAF 537.67) respectively. For the real prices, these values are CFAF 292.77 (2007) and CFAF 436.45 in 2014 respectively. As it is seen, unit prices of this product are relatively lower than those of all others products studied. Prices increase rapidly after 2009 with a normal increasing trend.

Table 4.38. Changes in Annual Consumer Prices of Cassava Tuber (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	357.42	100.00	100.00	284.46	125.65
2006	317.17	88.74	88.74	307.94	103.00
2007	303.17	84.82	95.59	331.41	91.48
2008	342.83	95.92	113.08	354.88	96.60
2009	332.58	93.05	97.01	378.36	87.90
2010	375.58	105.08	112.93	401.83	93.47
2011	386.58	108.16	102.93	425.30	90.90
2012	432.00	120.87	111.75	448.77	96.26
2013	505.75	141.50	117.07	472.25	107.09
2014	537.67	150.43	106.31	495.72	108.46
2015	529.42	148.12	98.47	519.19	101.97

Source: (Author's calculation from data)

Table 4.39. Changes in Annual Consumer Prices of Cassava Tuber (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	357.42	100.00	357.42	100.00	100.00	293.74	121.68
2006	317.17	98.59	321.70	90.01	90.01	306.33	105.02
2007	303.17	103.55	292.77	81.91	91.01	318.93	91.80
2008	342.83	109.00	314.52	88.00	107.43	331.52	94.87
2009	332.58	111.06	299.47	83.79	95.21	344.12	87.02
2010	375.58	112.68	333.32	93.26	111.30	356.72	93.44
2011	386.58	114.11	338.78	94.79	101.64	369.31	91.73
2012	432.00	117.15	368.77	103.18	108.85	381.91	96.56
2013	505.75	117.71	429.66	120.21	116.51	394.50	108.91
2014	537.67	123.19	436.45	122.11	101.58	407.10	107.21
2015	529.42	122.82	431.04	120.60	98.76	419.70	102.70

Source: (Author's calculation from data)

The Table 4.38 shows changes in current prices of cassava. Between 2005 and 2015 price of cassava tuber increased 48.12% compared to the base year, this change for the real price is shown in the Table 4.39 and represents 20.60%. As it can be seen from the trend line equations, annual current and constant prices increase CFAF 23.47 and CFAF 12.60 respectively. Annual price variations of cassava tuber during the research period give an average of 3.6% and 1.7% for current and real price respectively. Cassava production increased for 28% and a great part of this increase comes mainly from increases in cassava-cultivated area, whereas yield increase accounts only 5% according to FAO (2018). Thus, despite this production increases with imports, prices increased during the study period. According to the economic theory, prices are determined by the combined effect of supply and demand. It is evident that although supply is increasing, it still cannot meet demand.

4.4.1.2. Monthly Fluctuations in Cassava Tuber Prices

Table 4.40. Monthly Fluctuations in Cassava Tuber Consumer Prices

Months	Price mear (CFAF/kg)	Corr. Coeff.	Correctior	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon Inx (%)	CV (%)
January	379.73	-11	0.98	-10.76	368.97	92	22
February	375.18	-9	0.98	-8.80	366.38	91	23
March	396.27	-7	0.98	-6.85	389.43	97	26
April	382.91	-5	0.98	-4.89	378.02	94	20
May	383.27	-3	0.98	-2.93	380.34	95	23
June	392.91	-1	0.98	-0.98	391.93	98	27
July	427.82	1	0.98	0.98	428.80	107	22
August	429.09	3	0.98	2.93	432.03	108	28
September	411.09	5	0.98	4.89	415.98	104	22
October	411.55	7	0.98	6.85	418.39	104	20
November	406.27	9	0.98	8.80	415.08	103	23
December	425.91	11	0.98	10.76	436.67	109	24
Mean	401.83	0.00	0.98	0.00	401.83	100.00	

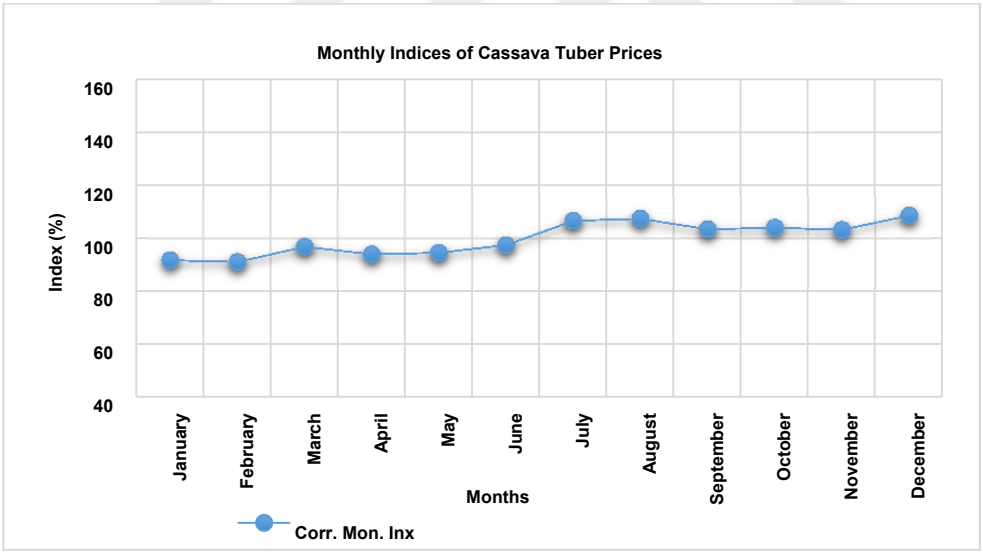

Figure 4.30. Monthly Indices of Cassava Tuber Prices.

The Table 4.40 shows seasonal fluctuations in cassava tuber prices. As it is seen from the table, the highest prices occur in December. During this month,

cassava price is 9% higher than the mean annual price. The lowest cassava prices were observed in February. During these months, cassava prices are 9% below the mean annual prices. The representation of the price movements is better presented in the Figure 4.30. The coefficient of variation is also greater in August, meaning that prices are showing greater variations compared to the other months. Cassava prices are max in December and in summer months (July 107% and August 108%) since the demand for it is also high in these seasons. In fact, the planting of cassava in Gabon is done over four main months, February and March for the modern method; September and October for the traditional method. For early varieties, it takes at least 6 to 8 months for cassava to be harvested, while it takes at least 12 months for normal or late varieties according to the data from FAO (2018). As a result, the months of July and August are either at the beginning or at the end of the harvest depending on the culture method used. Thus, higher prices recorded during these two months could be explained by the particular position they occupy in the cassava production cycle, where the supply could no longer satisfy the demand.

Cassava is an important staple food. Great shortages are reported even at the beginning of 2019. There are shortages lasting for three months. Greatest part of cassava consumed in Libreville is imported from Cameroon, Congo and Ivory Coast. As a result, prices are also dependent on some international factors (Anonymous, 2018).

According to an FAO study there is a great correlation between cassava demand and urbanization in Gabon. In this study, percent increase of cassava production due to urbanization was estimated to be 11%. Probably this trend is continuing (FAO and IFAD, 2004).

4.4.2. Fang Cassava Stick

Figure 4.31. Fang Cassava Stick (*Manihot Esculenta*)

4.4.2.1. Trend Analysis for Fang Cassava Stick

Table 4.41. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.81	0.797	0.839	0.678	0.666	0.751
F	43.584***	20.669***	18.234***	22.027***	10.962***	11.036***
Std. Err.	49.956	51.575	46.119	42.403	43.178	37.295
D-W	1.485	1.0609	1.805	1.389	1.561	1.727
Cons.	483.371***	495.108***	523.472***	427.653***	439.806***	465.336***
X	31.446***	31.446***	31.446***	18.975***	18.975***	18.975***
X^2	-	-1.174	-11.022	-	-1.215	-10.080*
X^3	-	-	0.394	-	-	0.355*

Where: *** ($p<0.01$); ** ($p<0.05$); * ($p<0.10$)

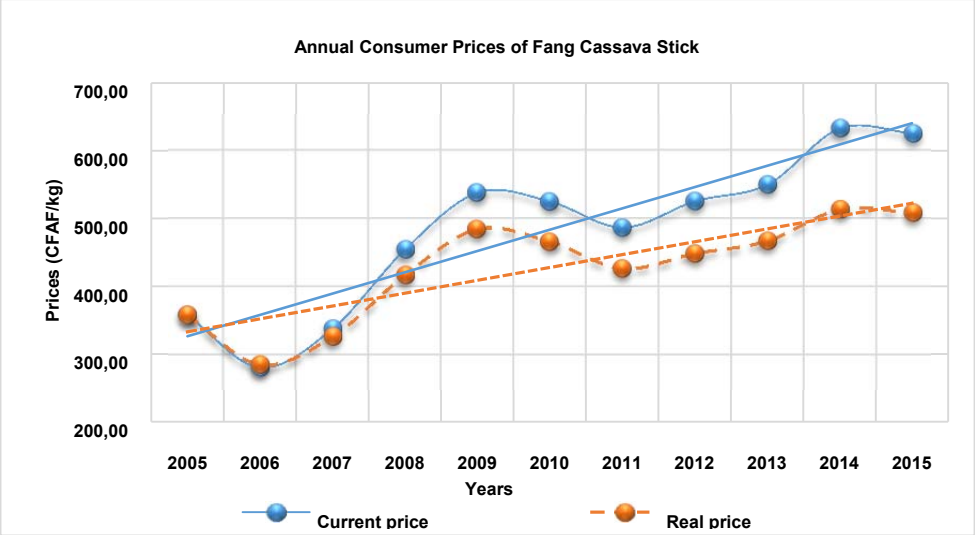

Figure 4.32. Annual Consumer Prices of Fang Cassava Stick
Source: (IGAD data, Libreville's consumer prices, 2016)

Fang cassava stick is made with cassava tuber crop. In Gabon, there are two or three kinds of cassava stick, but the most used and solicited at the Libreville market is fang cassava stick that is generally from the Northern Gabon. The Figure 4.32 shows the price results of fang cassava stick. The regression equation for the current price is **Y=483.371+31.45*X** and for the real price it is **Y=427.653+18.98*X**. All over the study period, the price of this product increased and remained unstable. The fact that this product is imported may influence its price. These fluctuations may also be related to the price changes of Cassava tuber since it represents the raw material for sticks.

Table 4.42. Changes in Annual Consumer Prices of Fang Cassava Stick (Current)

Years	Current price	Simple index	Chain index	Estimation (CFAF/kg)	(Cu/E)*100
	CFAF/kg	2005=100			
2005	358.67	100.00	100.00	326.14	109.97
2006	281.83	78.58	78.58	357.58	78.82
2007	338.58	94.40	120.14	389.03	87.03
2008	454.75	126.79	134.31	420.47	108.15
2009	538.17	150.05	118.34	451.92	119.08
2010	525.00	146.38	97.55	483.37	108.61
2011	486.83	135.73	92.73	514.81	94.57
2012	525.75	146.58	107.99	546.26	96.25
2013	550.00	153.35	104.61	577.70	95.20
2014	632.67	176.39	115.03	609.15	103.86
2015	624.83	174.21	98.76	640.60	97.54

Source: (Author's calculation from data)

Table 4.43. Changes in Annual Consumer Prices of Fang Cassava Stick (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	358.67	100.00	358.67	100.00	100.00	332.79	107.78
2006	281.83	98.59	285.86	79.70	79.70	351.76	81.27
2007	338.58	103.55	326.97	91.16	114.38	370.74	88.20
2008	454.75	109.00	417.20	116.32	127.59	389.71	107.05
2009	538.17	111.06	484.58	135.11	116.15	408.69	118.57
2010	525.00	112.68	465.92	129.90	96.15	427.66	108.95
2011	486.83	114.11	426.64	118.95	91.57	446.64	95.52
2012	525.75	117.15	448.79	125.13	105.19	465.61	96.39
2013	550.00	117.71	467.25	130.27	104.11	484.59	96.42
2014	632.67	123.19	513.57	143.19	109.91	503.56	101.99
2015	624.83	122.82	508.73	141.84	99.06	522.54	97.36

Source: (Author's calculation from data)

The Table 4.42 shows the variations of the current consumer price. The simple index column illustrates that the price over the study period moved for 74.21%. This rate seems too considerable for a product that represents a staple food in a given country. The price fluctuations over the study period justify the significant instability that consumers face to buy this product on the market. As for the real price, the Table 4.43 shows similar observations as in the movements of the current price. During the period going from 2005 to 2015, real price increased by 41.84%. Annual current and real fang cassava stick's prices increased on average 5.18% and 3.23%, respectively during the same period.

4.4.2.2. Monthly Fluctuations In Fang Cassava Stick Prices

Table 4.44. Monthly Fluctuations in Fang Cassava Stick Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff.	Correction	Total Corr.	Corr. Mean (CFAF/kg)	Corr. Mon. Inx (%)	CV (%)
January	471.09	-11	1.31	-14.41	456.68	94	26
February	474.55	-9	1.31	-11.79	462.75	96	26
March	459.91	-7	1.31	-9.17	450.74	93	25
April	482.55	-5	1.31	-6.55	475.99	98	24
May	472.73	-3	1.31	-3.93	468.80	97	26
June	472.91	-1	1.31	-1.31	471.60	98	23
July	486.09	1	1.31	1.31	487.40	101	24
August	481.73	3	1.31	3.93	485.66	100	27
September	486.73	5	1.31	6.55	493.28	102	22
October	485.36	7	1.31	9.17	494.54	102	28
November	506.09	9	1.31	11.79	517.88	107	27
December	520.73	11	1.31	14.41	535.14	111	23
Mean	483.37	0.00	1.31	0.00	483.37	100.00	

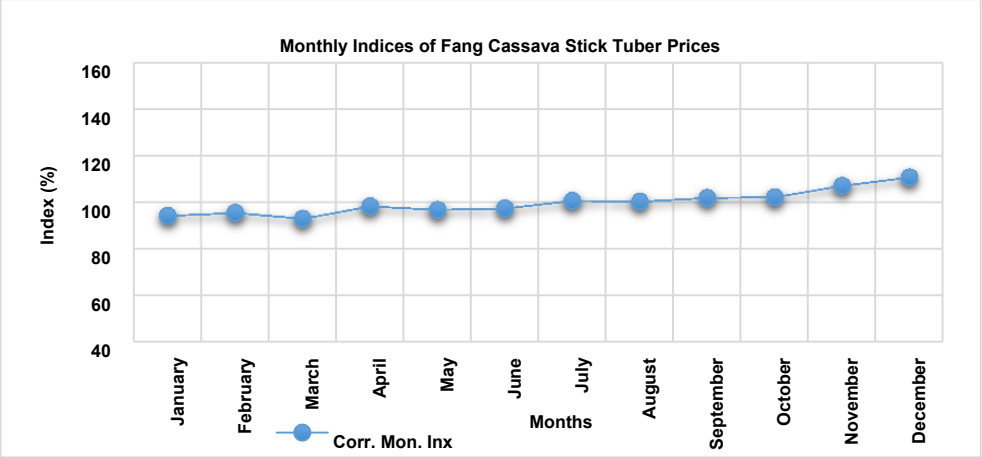

Figure 4.33. Monthly Indices of Fang Cassava Stick Tuber Prices.

The Table 4.44 presents the monthly fluctuations of fang cassava stick prices. In the corrected monthly index column, the index of each month shows that the price over the year does not variate a lot. The month of March, with 7% below of the annual mean prices, recorded the lowest prices of this product. In the study of this crop, December presented the highest prices, with 11% on the average mean price (Figure 4.33). As shown in the coefficient of variation column, the values of these monthly price variations remain between 23% to 28% over the years. Importations of this product was also evoked during the study (IGAD, 2016 and FAO, 2018) but since data were not sufficiently provided, it is difficult to clearly mention and measure the impacts on the price of this product. However, import always play a role in the fluctuations of the price of one product. For example the Figure 4.33 shows the price is usually very close to the annual mean price over the years and for such situations, import data may help to understand better the role played by import in this price regulation. Thus, more studies are needed to determine exact quantities concerned by the import of this product.

4.4.3. Plantain

Figure 4.34. Plantain (*Musa* × *Paradisiaca*).

Plantain is a hybrid species of plant of the *musaceae* family. Like banana dessert, it is a subgroup of the species *musa* × *paradisiaca*, which is originated from the crossing between *musa acuminata* and *musa balbisiana*. Plantain is simply called plantain in Africa. The ancestors or modern bananas and plantains are from South-East Asian and Western Pacific regions. It can still be found in the natural forest vegetation today. Linnaeus originally used the name *M. paradisiaca* only for plantains or cooked bananas. Plantain is generally produced in tropical countries. The humid tropics possess adequate temperatures that facilitate the growth and the development of plantain. In fact, these regions are more favorable than the cool subtropics. Plantains and other cooking bananas are mostly consumed locally and only 1.62% of the world plantain production is exported. Plantain is a staple food in the tropical regions. This product is ranked among the tenth most important staple food in the world, particularly in the developing countries. Plantain is a reliable all-season staple food (Robinson and Galán, 2010).

4.4.3.1. Trend Analysis for Plantain

Table 4.45. Trend Models for Annual Consumer Prices

	Current prices			Constant prices		
	Linear	**Quadratic**	**Cubic**	**Linear**	**Quadratic**	**Cubic**
R^2 adj	0.945	0.969	0.968	0.761	0.826	0.834
F	173.642***	158.411***	100.620***	32.928***	24.786***	17.688***
Std. Err.	24.114	18.082	18.543	24.385	20.81	20.373
D-W	1.958	3.344	3.454	2.105	2.861	3.068
Cons.	706.69***	724.165***	719.040***	629.175***	644.005***	635.618***
X	30.297***	30.297***	30.297***	13.341***	13.341***	13.341***
X2	-	-1.747**	0.033	-	-1.483*	1.429
X3	-	-	-0.071	-	-	-0.116

Where: *** (p<0.01); ** (p<0.05); * (p<0.10)

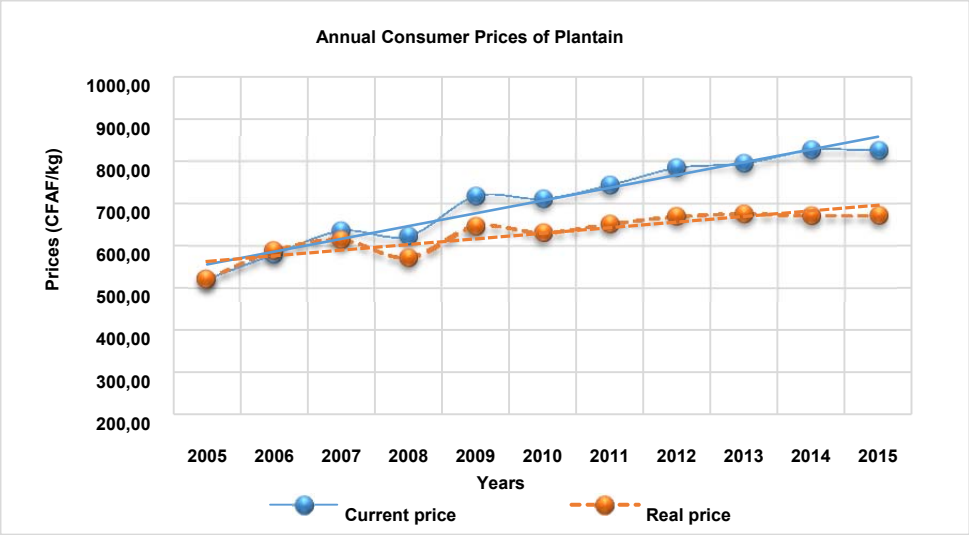

Figure 4.35. Annual Consumer Prices of Plantain
Source: (IGAD data, Libreville's consumer prices, 2016)

Plantain, just like cassava tuber or fang cassava stick, is one of the major agricultural products used for nutrition in Gabon. Plantain is locally produced and imported. Sometimes, this product does not need big investments in its production process. However, there is a quasi-linear and constant increase of the prices, as the Figure 4.35 indicates. After regression, the resulted equations are, **Y=706.69+30.297*X** for the current price and **Y=629.18+13.34*X** for the real price. As for the current price, the highest value is observed in 2014 (CFAF 827.67) and the lowest in 2005 (CFAF 522.00). Regarding the real price, the highest value is registered in 2014 (CFAF 676.03) and the lowest in 2005 (CFAF 522.00). According to FAO (2018), during the study period, plantain production increase of by 1%. During the same period, the yield of this culture decreased in the rate -7%. These indicators seem to indicate an increase in plantain cultivation area.

Table 4.46. Changes in Annual Consumer Prices of Plantain (Current)

Years	Current price	Simple index	Chain index	Estimation	(Cu/E)*100
	CFAF/kg	2005=100		(CFAF/kg)	
2005	522.00	100.00	100.00	555.22	94.02
2006	581.25	111.35	111.35	585.51	99.27
2007	636.50	121.93	109.51	615.81	103.36
2008	624.17	119.57	98.06	646.11	96.60
2009	718.42	137.63	115.10	676.41	106.21
2010	711.92	136.38	99.10	706.70	100.74
2011	744.50	142.62	104.58	737.00	101.02
2012	785.33	150.45	105.48	767.30	102.35
2013	795.75	152.44	101.33	797.59	99.77
2014	827.67	158.56	104.01	827.89	99.97
2015	826.17	158.27	99.82	858.19	96.27

Source: (Author's calculation from data)

Table 4.47. Changes in Annual Consumer Prices of Plantain (Constant)

Years	Current price	Consumer price index	Real price	Simple index	Chain index	Estimation (CFAF/kg)	(R/E)*100
	CFAF/kg	2005=100	CFAF/kg	2005=100			
2005	522.00	100.00	522.00	100.00	100.00	562.46	92.81
2006	581.25	98.59	589.56	112.94	112.94	575.80	102.39
2007	636.50	103.55	614.68	117.75	104.26	589.15	104.33
2008	624.17	109.00	572.63	109.70	93.16	602.49	95.04
2009	718.42	111.06	646.89	123.92	112.97	615.83	105.04
2010	711.92	112.68	631.80	121.04	97.67	629.17	100.42
2011	744.50	114.11	652.44	124.99	103.27	642.51	101.55
2012	785.33	117.15	670.38	128.43	102.75	655.86	102.21
2013	795.75	117.71	676.03	129.51	100.84	669.20	101.02
2014	827.67	123.19	671.86	128.71	99.38	682.54	98.44
2015	826.17	122.82	672.65	128.86	100.12	695.88	96.66

Source: (Author's calculation from data)

According to the regression model, plantain annual current and real prices increase CFAF 30.297 and CFAF 51.03 respectively. In the Table 4.46, current prices increased 58.27% compared to the base year while the same indicator gives 28.86% of increase for the real price in the Table 4.47. Thus, increase in current term represents two times that observed in constant term. During the study period, Annual current and real plantain prices increased on average 4.26% and 2.33% respectively. During the same period, there is an increase of 1% of plantain production. This increase is totally related to the expansion of plantain-cultivated area. There is a decrease of 7% concerning the yield evolution, according to the statistics revealed by FAO (2018). Despite the negligible production increase, prices increased during this period. In 2014, 6995 tons were supplied to the Libreville market, of which 4463 tons were imported from Cameroon. Thus, more than half (64% in 2014) of the total plantain sold was imported and this may contributes to better explain the price increasing for this product. Even though the

supply of this crop is increasing, the demand at Libreville market is still to be satisfied.

4.4.3.2. Monthly Fluctuations in Plantain Prices

Table 4.48. Monthly Fluctuations in Plantain Consumer Prices

Months	Price mean (CFAF/kg)	Corr. Coeff	Correctio	Total Corr.	Corr. Mea (CFAF/kg)	Corr. Mon Inx (%)	CV (%)
January	681.27	-11	1.26	-13.89	667.39	94	13
February	701.45	-9	1.26	-11.36	690.09	98	17
March	708.91	-7	1.26	-8.84	700.07	99	14
April	707.36	-5	1.26	-6.31	701.05	99	15
May	683.55	-3	1.26	-3.79	679.76	96	18
June	689.00	-1	1.26	-1.26	687.74	97	19
July	741.64	1	1.26	1.26	742.90	105	14
August	773.18	3	1.26	3.79	776.97	110	27
September	701.18	5	1.26	6.31	707.49	100	17
October	688.45	7	1.26	8.84	697.29	99	15
November	685.45	9	1.26	11.36	696.82	99	17
December	718.91	11	1.26	13.89	732.80	104	11
Mean	706.70	0.00	1.26	0.00	706.70	100.00	

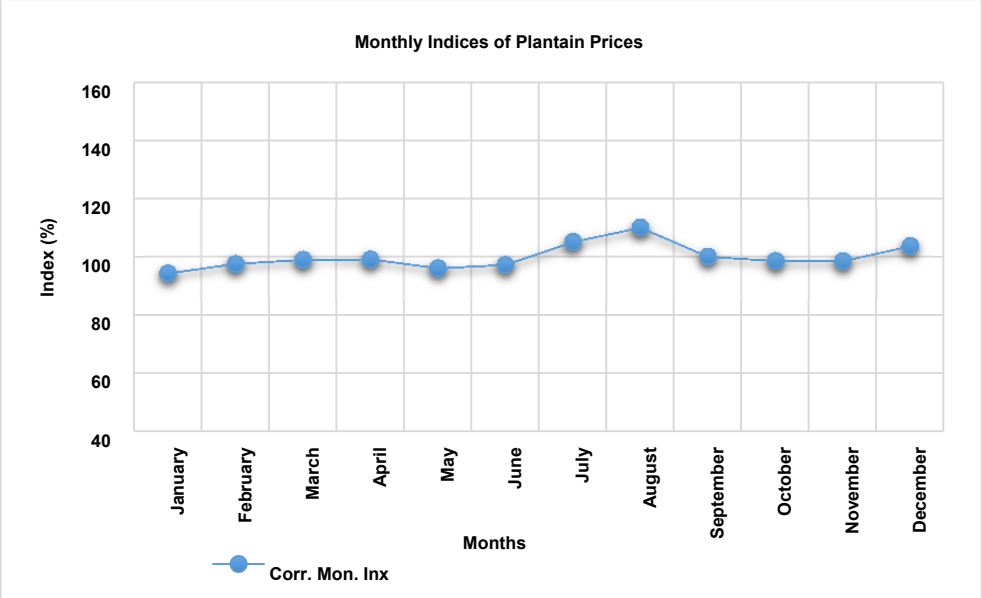

Figure 4.36. Monthly Indices of Plantain Prices.

The Table 4.48 shows the variations of the plantain monthly prices. During the years concerned by the study of this crop, August, with 9% above the mean annual price registered the highest value. November, with 5% below the annual mean prices, registered the lowest price. Concerning the coefficient of variation column, August is the month that also got the highest monthly coefficient of the price variations over the study period. The prices are sensibly constant over the year (Figure 4.36), but July and August reach high values. These values are obtained during the summer holiday and plantain is in its growth period at that particular time. That is the reason why the demand of this product cannot be satisfied. Despite the fact that the price does not fluctuate too much, there is still a little increase the price from February to April because it is located in the planting time of plantain. It is also necessary to underline the fact that the importation of this product (64% in 2014) may highly contribute to the increase and fluctuation of its prices.

This study has enabled to evaluate several aspects related to the prices of the crops selected in the frame of this work. Thus, Tables 4.49 and 4.50 show a large part of the annual results obtained during the study period.

Table 4.49. Global change in prices and other parameters (2005-2015)

Products	Mean Annual change of prices (%)		Changes (%) (2005-2015)			
	current	real	current prices	real prices	Yield	Production
Basil	1.83	-0.05	22.14	-0.56	-10.00	30.00
Celery	2.02	0.14	24.67	1.5		
Amaranth	-0.68	-2.52	-7.24	-24.48		
Black nightshade	3.26	1.35	42.30	74.78		
Lettuce	-1.87	-3.69	-18.79	-33.88		
Roselle	3.15	1.24	40.65	14.52		
Pepper	5.99	4.02	89.56	54.33		
Tomato	2.30	0.41	28.42	4.56	-0.20	9.00
White eggplant	2.69	0.79	33.88	9.01	-0.10	67.00
Cassava tuber	3.64	1.72	48.12	20.6	5.00	28.00
Fang cassava stick	5.18	3.23	74.21	41.84		
Plantain	4.26	2.33	58.27	28.86	-7.00	1.00

Source (Author's calculation)

Table 4.50. Price Changes for All Crops

products	Annual current price mean (CFAF/kg)	Annual real price change (CFAF/kg)	Annual current price change (CFAF/kg)	Annual real price change (CFAF/kg)	Annual current price change / mean	Annual real price change / mean
Fang Cassava Stick	483.37	427.65	31.45	18.98	6.51	4.44
Cassava tuber	401.83	356.72	23.47	12.60	5.84	3.53
Pepper	4316.48	3823.46	244.88	149.01	5.67	3.90
White eggplant	761.00	676.08	39.44	20.47	5.18	3.03
Plantain	706.70	629.17	30.30	13.34	4.29	2.12
Celery	2493.79	2221.86	104.46	41.57	4.19	1.87
Tomato	1009.25	900.70	34.95	10.46	3.46	1.16
Roselle	895.64	799.11	30.19	9.13	3.37	1.14
Black nightshade	798.04	712.38	21.91	4.14	2.75	0.58
Basil	2855.79	2552.94	62.27	-0.97	2.18	-0.04
Lettuce	1328.73	1198.17	-6.86	-36.38	-0.52	-3.04
Amaranth	562.08	506.42	-6.39	-16.90	-1.14	-3.34

Source (Author's calculation)

Table 4.50 shows the current and real price changes over the study period. The last two columns present in a descending order, the importance of the current and real price fluctuations. Therefore, it is clear that the price increase in Gabon mostly affects staple food. However, this phenomenon does not only concern Gabon, but also some countries all around the world.

5. RECOMMENDATIONS AND CONCLUSION

The prices of all crops (except amaranth and lettuce) are increasing each year in both current and real terms. Increases in staple crops (cassava tuber, fang cassava stick and plantain) are the highest ones together with that of pepper. Increases in the prices of staple crops are very important because they are consumed daily and the nutrition of people depends on them heavily. This is a big problem of Gabon, since it depends heavily on imports. It is clear that Gabon should take some measures to decrease imports and increase production. Because most of these crops are imported.

Decrease in the prices of amaranth and lettuce may be due to import substitution policy. In the past, these crops were also imported. However, by the establishment of IGAD in 1992, and launch of several projects including PRODIAG may have helped diminish price increases to some extent. PRODIAG was initiated in 2011. Similar policy should be practiced for staple crops and the kind of products as pepper.

This study shows that data collection and insemination are very important for these type of researches. For that reason, more accurate data should be compiled and distributed to the researchers. In order to solve price problems, import data have an important place because it is a part of supply. Supply consists of harvested products, product coming from storages, imported products. All these data are required to take this analysis further.

When we look at each crop separately, we can reach the following conclusions:

Basil and celery are classified as leafy vegetables with the specificity that they are used as aromatic leafy vegetables. These crops are not considered as staple food. Therefore, demand for them are relatively lower than that of staple crops such as plantain but significantly higher than that of the majority of leafy vegetables taken into account in this study. Their production is usually supported

by projects, as it was the case of the PRODIAG project. Their cultivation is relatively easy, but sometimes needs some investments. The two crops are frequently harvested and need three to four months for their maturation (80-120 days). These may be considered as the main cause of their price changes. However; further researches should be done in order to fill the lacking information related to these crops in this study.

Amaranth is classified as pseudo-cereal, but is neither a real cereal nor a staple crop. On one hand, its demand is not as high as the one of cassava. On the other hand, its production is supported by PRODIAG and other projects. Its cultivation is relatively easy, does not necessitate great investments. Amaranth's production receives foreign investments and is frequently harvested. These factors could be considered as the causes of the amaranth's price decline. However, further researches should be done for this crop.

Black nightshade and roselle are classified as simple leafy vegetables and demand for each is lower than the one of any staple crop. Two months are the minimum of time needed for their harvest. The production of black nightshade and roselle is generally supported by projects due to the fact that their production is relatively easy. Therefore, all the points evoked above may lead to the normal price variation observed as compared to the prices of other crops taken into account in this study. However, further studies need to be done.

Lettuce is a leafy vegetable usually used as cruciferous; this crop is not a staple crop. The demand of this culture is relatively lower than the demand of the majority of the crops, this may be due to its specificity to be a cruciferous, and that may limits its usage sometimes. This crop needs at least two months for harvest and does not require high investments. The production of this crop is generally supported by several projects. Lettuce can be harvested all the time and its price decrease observed in this study may be due to the advantages evoked above.

Tomato and pepper are classified as fruit-vegetables. The cultivation of these crops require warm temperatures. Thus, it seems difficult to produce them

every season. Even though the demands for these crops are relatively high as the one of staple crops, they are not considered as staple crops. The production of tomato and pepper require important investments and is generally supported by projects and other foreign initiatives. These crops are concerned by importation and their prices increase highly. Harvests occur after three months. In order to determine the exact causes alongside the factors evoked above, further studies should be conducted

White eggplant is a fruit-vegetable crop. It is a warm season crop that relatively requires high temperatures and needs at least 2 months for harvest. Its production necessitates investments sometimes and therefore is supported by the projects. The demand of this crop is similar to those of other fruit-vegetables. A part of the causes responsible of its high price increase observed during the study period may be originated from the reasons described above. However, more studies need to be conducted.

Cassava and plantain are both classified as staple crops by FAO. Staple crops are the crops that have a very high demand in terms of food consumption since they represent the basis. The cultivation of these crops requires investments and needs approximately 8 months for harvest. The production of these crops is, most of the time, supported by projects and other foreign initiatives. The harvest occurs at any time during the year but their high price increase are clearly explained by the role they play in the food consumption (staple food). This fact may also be similar in other countries around the world concerning as far as the staple food prices are concerned.

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APPENDIX

Appendix 1: Grouping Of Selected Crops According To Their Properties.

Aromatic Leafy Vegetables

Basil (*Ocimum Basilicum*).

Celery (*Apium Graveolens*).

Leafy Vegetables

Amaranth (*Amaranthus*).

Black Nightshade (*Solanum Nigrum*).

Lettuce (*Lactuca Sativa*).

Roselle (*Hibiscus Sabdariffa*).

Fruit Vegetables

Pepper (*Capsicum Annuum*).

Tomato (*Solanum Lycopersicum*).

White Eggplant (*Solanum Melongena*).

Staple Crops

Cassava Tuber (*Manihot Esculenta*).

Fang Cassava Leaf Roll.

Plantain (*Musa × Paradisiaca*).

Appendix 2: Seçilen Ürünlerin Niteliklerine Göre Gruplandırılması.

Aromatik Yapraklı Sebzeler

Fesleğen (*Ocimum Basilicum*).

Kereviz (*Apium Graveolens*).

Yapraklı Sebzeler

Amarant (*Amaranthus*).

Köpek Üzümü (*Solanum Nigrum*).

Marul (*Lactuca Sativa*).

Hibiskus Çayı Veya Mekke Gülü (*Hibiscus Sabdariffa*).

Meyve Sebzeler

Karabiber (*Capsicum Annuum*).

Domates (*Solanum Lycopersicum*).

Beyaz Patlıcan (*Solanum Melongena*).

Temel Gıda

Manyok Yumru (*Manihot Esculenta*).

Fang Cassava Stick. (*Manihot Esculenta*)

Yemeklik Muz (*Musa × Paradisiaca*).