

## Fluctuation in Coffee Production and Implications for Development in Noni Sub-Division

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### Abstract

Coffee cultivation is one of the main economic activities which is carried out by most farmers in some rural areas in Cameroon and it is a major source of livelihood. Over the years, the prices of coffee in the world market have been discouraging. Using primary and secondary sources of data, focus group discussion, this study investigates coffee cultivation in the Noni Sub-Division from the 1990s to 2014. It also looks at the general trends in coffee production in the Noni Sub-Division from 1990 to 2014. The results reveal that the cultivation of coffee in the area has been strongly affected by the low prices of coffee in the world market as well as the liberalization of the coffee sector in Cameroon. The study equally revealed that the socio-economic development of Noni Sub-Division strongly depends on the cultivation of coffee though the development is often affected by the low prices of coffee. The formation of Cooperative Societies in lagging areas, the stabilization of prices by the government and training of farmers will go a long way in improving on the coffee sector in this region and Cameroon as a whole.

**Keywords:** Coffee Production, Fluctuation, livelihood, Development, Noni Sub-Division

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### Introduction

Coffee is one of the legal international transacted commodities of many countries following petroleum oil. Consumers from all around purchase and enjoys it in their daily activities (Iscaro, 2014). In addition, Davis et al. (2012) identified during their study, that coffee is the second most transacted goods in the world. Predominately, Arabica represents 70% of global coffee production and Robusta represents about 30% (Damatta and Ramalho, 2006; Davis et al., 2012). The production and productive of both species are largely dependent on the climate for the attainment of high yields and quality (Killeen and Harper, 2016). Coffee requires very specific environmental conditions for successful production, depending on the coffee variety grown. But the crop is perennial, tropical crop that can grow under both humid lowlands and tropical humid/sub humid highlands. Even though the average temperatures required for coffee Arabic range between 15 and 24°C, rain fall 2000 mm per annum and altitudes between 1000 and 2000 m above sea level. Robust coffee required average temperature range between 24 and 30°C, rainfall ~2,000 mm and altitudes of about 800 m above sea level (Killeen and Harper, 2016).

Overall, influence of weather variations on coffee producing countries are predicted to be negative (Ovalle-Rivera et al., 2015). Some countries would lose area suitability while others would gain from variation in weather elements (Ovalle-Rivera et al., 2015). Ovalle-Rivera et al. (2015) reveals coffee producing areas such as America, Africa, Asia and Oceania would maintain some suitability for growing Arabica coffee. Ripeness is a factor of great importance to coffee quality and a large part of the defects known as blacks, greens or rancids (BGR). The cherry stage is considered the ideal point for quality (Folmer, 2014). However, selective harvesting of ripe fruit is labor intensive, which increases the production cost and often makes its practice non-viable (Silva et al., 2013). Coffee stands out as a worldwide product of great importance and is cultivated in more than 80 countries, with approximately 143.4 million of 60-kg bags production in 2015. Brazil is the largest producer and exporter and the second largest consumer of coffee in the world, with a production of about 55 million benefited bags in 2016 (ICO, 2017).

Coffee in Cameroon was introduced in 1905 by the colonial masters (German) and it was experimented on the slopes of Mount Cameroon and further extended to other parts of the country where coffee is presently grown (Adrianno, 2007). Two main varieties of coffee which are cultivated in Cameroon include: Robusta and Arabica. Robusta coffee thrives in the forest zone where humid and high temperature conditions prevail. Arabica coffee is grown on the mountainous regions situated between 1000metres and 1800metres with low temperatures ranging from 15°C to 25°C (Adrianno, 2007). In the past, the cultivation and marketing of coffee in Cameroon was in the hands of some organizations which worked in close collaboration with the intermediary cooperative societies. In the North West Region, for example the Produce Marketing Organization, was in charge of marketing the produce from farmers. It was also in charge of providing farm inputs at cheaper prices to farmers. By the 1990s this sector was liberalized mainly because of the economic crisis that affected the country and the fall in the prices of coffee in the World Market (Agra-net, 2015). Since then, the marketing of coffee has been in the hands of individuals through their Local Cooperative Societies.

For the past 20years in Cameroon, following the withdrawal of government subsidies in 1990, the liberalization of coffee sector and the devaluation of the CFA Francs forced small farmers to integrate their coffee

farms with other food crops leading to a fall in output or fluctuation in the production of coffee (Cameroon Coffee Development Strategy, 2014). This crop is grown alongside cola nuts and food crops. Coffee is economically important as it is the major source of income for most farmers. Coffee constitutes 5% of the agricultural Gross Domestic Product in Cameroon (International Coffee Organization 2015). Considering the fact that coffee is the second cash crop after cocoa in Cameroon, the government of Cameroon has for the past ten years been trying to re-generate this sector (Nchare, 2007). With the liberalization of the coffee sector in Cameroon, most of the coffee farms in this area were cleared in favour of food crop production like maize and beans which are perennial and yielded much income with steady market compared to coffee. With the relaunch of the coffee sector in Cameroon in 2008 and with the coming of the OLAMCAM many farmers have gone back to the planting of coffee. Most vast lands now in Noni Sub Division have been under cultivation especially with the introduction of the Java 2 type of arabica coffee by OLAMCAM. Since the 1990s with the liberalization of the coffee sector in Cameroon, there has been fluctuation in the production of coffee. Based on the above therefore, this paper seeks to examine the general trend of coffee production in Noni Sub-Division from 1990 to 2014; examine the drivers of coffee productions, and the impact of the fluctuation in coffee production on the economic development of Noni Sub Division

### **Methodology**

Data was collected through field observations, interviews and administration of questionnaires. Field observations enable us to identify the species of coffee, farming techniques and processing activities at local level. Interviews were conducted with some officials of the Noni Area Cooperative Union, with the coordinators of OLAMCAM in six villages in Noni Sub-Division as well as some key coffee farmers in the six sampled villages in the region, to get information on the evolution of the coffee sector in the study area under study from 2006 to 2015. 100 questionnaires were administered using a proportionate random sampling method. The sampling frame constituted the six villages that make up Noni Sub Division. These villages were proportionately chosen so that both the Upper Noni and Lower Noni were covered. In this light, the sample frame comprised Djottin and Din for Upper Noni and Dom, Nkor, Mbinon and Lassin for the Lower Noni. With these questionnaires, coffee farmers were able to express their personal views on coffee cultivation for the past 20 years as well as the relation between coffee price and development in Noni Sub-Division. Data on production trend and market prices was collected from the archives of the Noni Area Cooperative Union as well as those of some Village Cooperative Societies. This gave us the trends in coffee production for the past 20 years. Climatic data collected from the Sub-Divisional Delegation of Agriculture and this gave us a clue on the fluctuations in climatic conditions and the effect on crop cultivation and management. Maps were used to show the different relief forms and the spatial distribution of coffee farms and cooperative societies. Pictures were taken to illustrate some salient points raised in the discussion.

Data collected from the various sources was analysed and presented on tables, in percentages, averages, graphs and pie charts. Line graphs and bar graphs were also developed from the data obtained to show the trends in coffee production over the past 20 years. To illustrate the relationship between fluctuations in coffee production and fluctuations in price over the 20 years in Noni Sub Division, the Product Moment Correlation ( $r$ ) was used. The two variables were coffee and price.

### **Factors Favouring Coffee Production in Noni Sub - Division**

Noni Sub Division in Bui Division of the Northwest Region of Cameroon lies between longitude  $10^{\circ}31'$  and  $10^{\circ}38'$  East of the Green Wiche Meridian and between latitude  $6^{\circ}15'$  and  $6^{\circ}28'$  North of the Equator. This area is bounded to the northwest by Donga-Mantung Division, to the southwest by Oku Sub Division and in the East and south by Kumbi Sub-Division (Figure 1). The prevailing climate here with heavy rainfall, high intensity of sunshine, high temperature provide favourable conditions for the cultivation of coffee. This particular climatic condition is complemented by the relief as well as soil condition which favours the cultivation of coffee. Coffee cultivation in Noni is not uniformly distributed as there are areas with high, moderate and low rate or amount of coffee production. The upper Noni which consists of Djottin and Din are main areas of high coffee production. Lower Noni which is mainly the lowland areas has very low rate of production particularly in Nkor and Lassin. Mbinon and Dom in lower Noni have moderate rate of production.

Noni Sub-Division falls within the humid tropical region which characterizes the Bamenda High Lands of the North West Region of Cameroon. The area receives a considerable amount of rainfall and sunshine which enhance the production of Arabica coffee. This climate is made up of two seasons which are rainy and the dry seasons. The rainy season in Noni starts from mid February and ends around mid October with annual rainfall between 1800mm and 2200mm with highest intensity in July and August. The dry season starts around mid October and progressively continues to February. These two seasons in Noni are all favourable for coffee production. The beginning of each season is just enough to ensure the flowering, maturity, repining and harvesting of coffee. The flowering of coffee plants and the formation of young cherries start from March. Immediately the rains subside by September harvesting progressively begins. The amount of sun shine and atmospheric moisture

content during this period is enough to enhance ripening, sunning and transportation of the coffee beans. The main form of precipitation is rainfall during which ground water recharge takes place and nourishes the coffee plants. The light rainfall around March coupled with the mild winds during this period facilitates the flowering of coffee. When the intensity of rainfall starts to increase by May, the development of the coffee cherries starts and gets mature by August. The gradual arrival of the dry season by September with a reduction in amount of rainfall leads to gradual ripening of coffee. All the climatic elements like rainfall, temperature, sunshine, mild winds and atmospheric humidity all combine to give a favourable climatic condition for the cultivation of coffee in Noni. Low land areas like Nkor and Lassin are comparatively warmer whereas high relief areas like Nkale Din, Djottin, Dom and Mbinon are moderately cool. The activities of farmers such as planting, tilling, cleaning, pruning, harvesting, drying, and transportation are, to a large extent, controlled by these climatic conditions (Table 1).

Table 1: Calendar of Activities based on changing Climatic Conditions

| Months                           | Activities  | Prevalling Climatic Conditions   |
|----------------------------------|---|--|
| December<br>January<br>February  | drying of coffee beans,<br>Tilling of the coffee farms to aerate the soil, pruning of unwanted stems to avoid excess moisture loss.             | The availability of sunshine and absence of rainfall favours the activity.   |
| March<br>April<br>May            | tilling of the farm to regain moisture through precipitation, to balance the excess moisture loss during dry seasons                            | Mild wind, light rain fall, mild sunshine together with the green chlorophyll in coffee enhances flowing of coffee.  |
| June<br>July<br>August           | application of fertilizers,<br>farmers clear farms,<br>Planting of new coffee stands, secondary pruning to improve on the quality of the beans. | Rain begins to increase in intensity and soil moisture content begins to increase.<br>Proper absorption of nutrients by coffee plant. This condition is favourable for the maturing of coffee cherries |
| September<br>October<br>November | harvesting begins at small scale and continue to November, pruning of unproductive stem   | Sunshine starts and humidity increases as rainfall decreases giving favourable condition for ripening and harvesting   |

Source: Field work, 2014

### Relief and soil

Relief is a major determining factor in the growth and development of Arabica and java coffee species. Coffee is grown on all slopes within the specific climatic conditions except on cohesive slopes with gradient ranging from 45° to 55°. With regards to Noni Sub-Division it strives on slopes, lowlands and valleys with variation in the intensity. The slopes are north facing, with an average gradient between 15° to 25° (Figure 2). It should be noted that Noni Sub-Division is made up of highlands and lowlands with an average altitude of 1200m above sea level with highest peaks in Dom (2000m). The gradient of the slopes facilitates good drainage, exposure to mild winds and sun shine since there are north facing. This explains why there is high intensity of Arabica coffee cultivation in upper Noni, low intensity in lower Noni particularly in Nkor and Lassin and the moderate intensity in Dom and Mbinon. Figure 3 illustrates the spatial distribution of coffee farms with respect to relief as testified by the coffee farmers in the Noni villages.

Fig. 1: Locaton of the Study Area

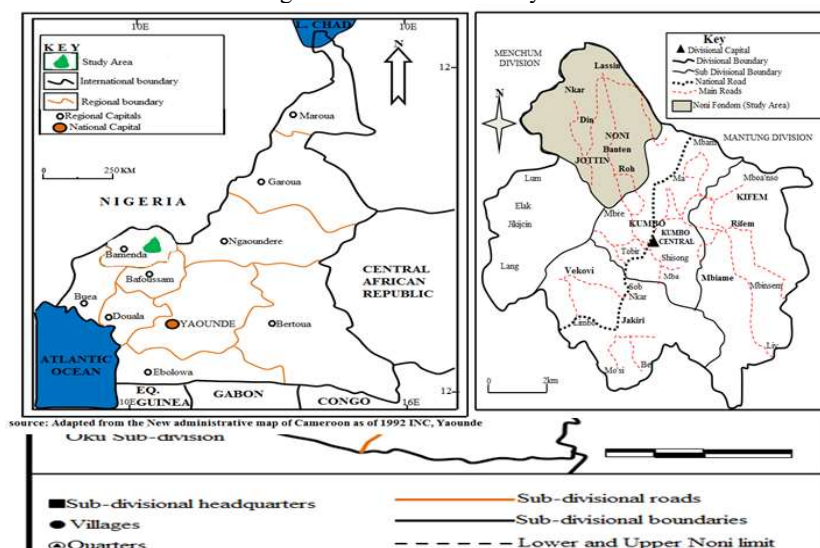
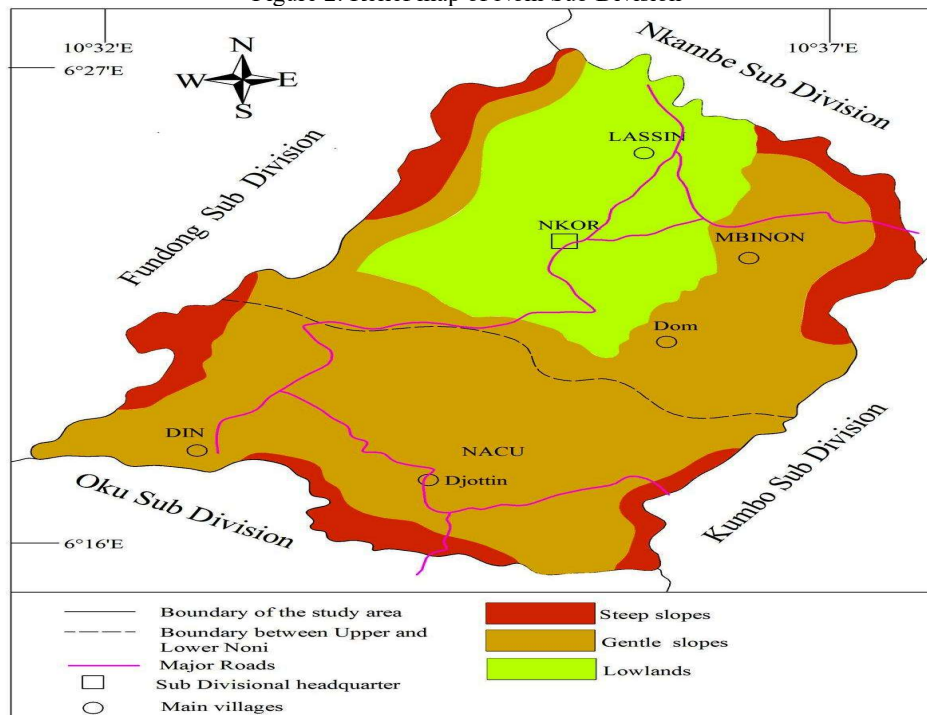
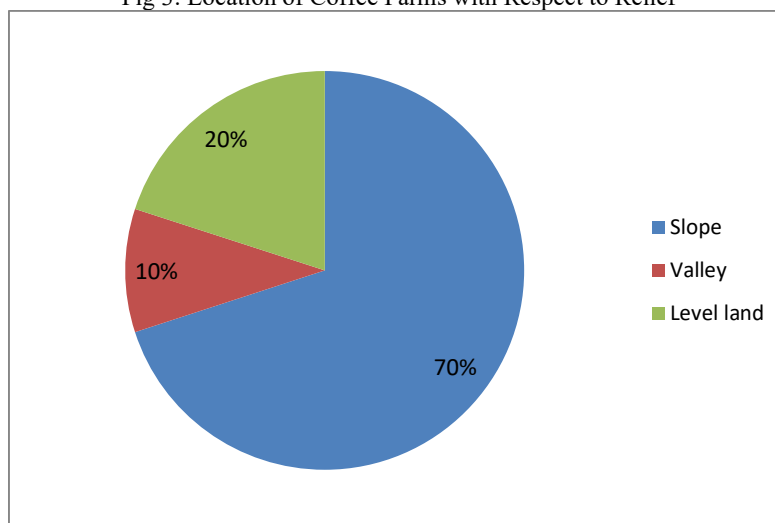


Figure 2: Relief map of Noni Sub Division



Source: Adopted from the Nkor Rural Council

Fig 3: Location of Coffee Farms with Respect to Relief



Source: field work December 2014

From the above figure most of the farms are found on slopes (70%) which are mostly in upper Noni areas. 20% of the farms are on lowlands and 10% in valleys mostly lower Noni particularly in Nkor and Lassin.

The soils of this region are fertile and are a continuation of the volcanic type extending from the Cameroon Mountain to the western highlands. These are black brown soils which are formed from the basaltic rocks. Soil profiles are extremely deep and fertile and are responsible for numerous agricultural holdings found in this area. Within this generalization, there also exist considerable differences in soils within the Noni Sub-Division. Low lying areas like Nkor and Lassin have mainly hydromorphic soils and are poorly drained and water logged suitable for vegetable and maize production and not favourable for the cultivation of arabica coffee. The steeper gradients of above 45° have skeletal soils with limited humus content and do not favour coffee cultivation. This is the case of some areas like the steep hills of Dom and Kingim and Mshiang in Djottin as well as Evun in Din, all in upper Noni (Figure 2). The areas of gentle relief thus favour the cultivation of coffee production in most parts of the Noni

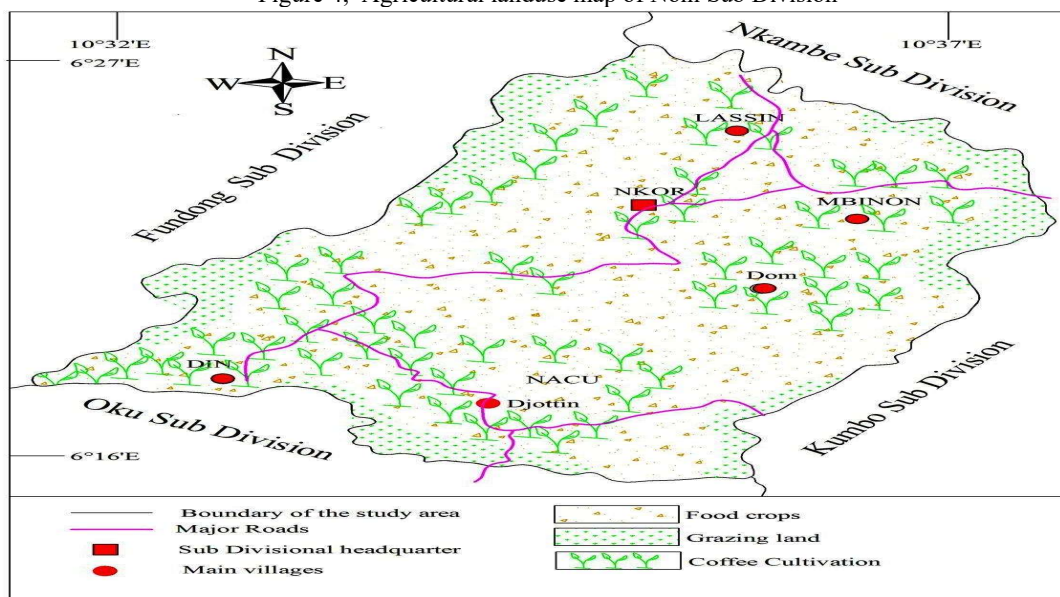
### Sub Division.

An increasing proportion of the area is vegetated by coffee farms particularly closer to the homes. Maize and beans cultivation, especially during the wet season also constitutes part of the vegetation. Bananas, oranges, mango trees and palm bushes equally occupy a great deal of land in Noni. Cattle rearing has taken over areas that are occupied by patches of grassland. The decomposition of this vegetation and leaves of the trees contribute to the fertility of the soils which favours the growth of Arabica coffee. These trees also serve as shade for most of the coffee farms and add to the increasing coffee yields. However, vegetation has declined significantly as there is constant quest for settlement, crop cultivation and more coffee farms. Drainage is also an indispensable factor that affects agriculture in general and coffee cultivation in particular. Precipitation rates are directly influenced by the amount of evaporation from the surface. In fact, rivers, streams and lakes play an important role in determining the drainage of a region. Noni is well drained by streams and rivers whose courses have been highly interrupted by the irregular nature of its topography. Their regimes and volumes are never constant due to seasonal changes and consequently the rates of precipitation.. Several smaller streams exist and combine to flow into River Katsina Ala in Nigeria. Enough water is provided and hence evaporation rates are high, condensation and precipitation is increased especially during the wet season which allows for the growth of coffee and other crops.

### Land availability

Land is one of the vital physical factors in the cultivation of coffee in Noni. There exists enough arable land in the area as more than  $\frac{2}{3}$  of the arable land is uncultivated. With the coming of OLAMCAM to Noni Sub-Division in 2008, education on coffee cultivation has been given to farmers coupled with the introduction of the Java 2 species of coffee. With the availability of land, most farmers have been opening new farms for the planting of the new species. With the presence of this vast arable land favourable for the cultivation of coffee, farmers have been very much encouraged to open new farms especially the youths. From field report, 80% of the farmers have access to land and are developing it. 10% have access to land but have not started developing it because of lack of finance and 6% of the farmers have no access to excess land for coffee cultivation and 4% have conflict over arable land for coffee cultivation mainly as a result of land tenure, whereby some parcels of land are strictly for some particular families. It is thus evident that there exists enough arable land for coffee cultivation in Noni, which has encouraged most youths to embrace coffee cultivation. Figure 4 below shows the land use of Noni with respect to coffee cultivation, food crops cultivation and cattle rearing. The map reveals that the gentle slopes of the area are for the rearing of cattles. Hence there is a relationship between relief and agricultural types. It was also observed that besides the prevailing physical conditions favouring the cultivation of Arabica coffee, human factors such as availability of market, training and farm management. also play a vital role in the coffee production.

Figure 4; Agricultural landuse map of Noni Sub Division



Source: Adapted from the Sub Divisional delegation of Agriculture and Rural Development

### Availability of market

Many organizations exist at international, national and regional, as well as, the local level to help the farmers sell

their produce. Before the liberalization of the coffee sector in Cameroon in the 1990s, there existed the National Produce Marketing Board (NPMB), which was in charge of coffee production and commercialization in the country particularly in the North West and South West Regions. With this organization, farmers were able to sell their coffee, as well as receive farm inputs at moderate prices. In the North West region, for example we had the marketing board and the North West Cooperatives Association (NWCA) with subsidiary cooperative Unions and cooperative societies through which farmers channeled their coffee for marketing. Before 1995 when the Noni Area Cooperative Union (NACU) was created, Noni area was part of the Oku Noni Cooperative Union, where farmers, under their local cooperatives societies, could sell their coffee. By 1995 Noni Area Cooperative Union was formed and most farmers in all the villages were members but in 2008 the union collapsed due to mismanagement. However, farmers continued to sell their coffee to individual buyers until OLAMCAM came in 2008. The coming of OLAMCAM was to educate farmers on coffee cultivation, as well to buy coffee from farmers. It was only in 2014 that the defunct Noni union was reorganized for farmers to channel their coffee for marketing. Thus, in Noni Sub Division, there have always been channels for the farmers to sell their coffee. Although the Noni Area Cooperative Union (NACU) in Djottin was re-organised in 2014, some farmers still prefer to sell their coffee to OLAMCAM and individual buyers This is because the Union was mismanaged and many farmers lost their faith in them. Consequently, the greater proportion of coffee today in Noni is sold to OLAMCAM and this can be explained by the fact that payment with OLAMCAM and individual buyer is instant.

### **Farm management/training**

Farm management refers to the act of taking good care of the farm to maximize output. It refers to activities like pruning the stem, clearing the farms, tilling and application of chemicals at the right time and in the correct quantity. Most farmers here have been educated by OLAMCAM on how to manage their farms and field reports show that 80% of coffee farmers in Noni attain educative meetings offered by OLAMCAM to improve on coffee cultivation. Farm inputs have also been given to farmers at cheaper rates as well as awards given to best coffee farmers by OLAMCAM in the form of farm inputs. With this education from OLAMCAM, most of the youths have been encouraged to cultivate coffee in a large scale. A new style of pruning has also been introduced by OLAMCAM known as the Multiple Stem Method which allows much young stems to generate from an old stem. This pruning is now done with the use of pruning scissors and hand saw against the use of machetes in the past. Farmers have also acquired knowledge on how to apply fertilizers and the use of pesticides to improve on their produce. With this education, most farmers in Noni know how and when to prune their coffee, till their farms, apply fertilizer and the type of shed plant to be planted in their coffee farms. However, with this training, some farmers still do not practise all these activities because of lack of finance to manage their farms.

### **Trends in Coffee Production in Noni Sub-Division From 1970 to 2015**

Over the past two decades, there has been a fluctuation in the production of coffee in the study area. The trends in coffee production indicate that there are some periods where coffee production was high with so many farmers involved and with the opening of new farms, as well as the application of fertilizers and pesticides and subsidies from the Cameroon government. This was the period before the economic crisis. During and after the economic crisis, coffee production dropped as farmers abandoned coffee farms and cleared down the coffee stems in favour of food crops which yielded much revenue with an available market than coffee This particular period was characterized by the drop in the prices of coffee in the world market, the devaluation of CFA currency and the liberalization of the coffee sector in Cameroon. However, since 2000 there has been a gradual rise in coffee production and this is a result of the government's involvement in the sector and other stake holders like OLAMCAM. These stakeholders have been educating and training farmers in Noni Sub Division on how to cultivate Arabica coffee coupled with the fact that coffee prices in the world market has increased.

During the period 1970 to 1979, in Noni Sub Division, so many farmers were encouraged to grow coffee as it was one of the main cash crops of the country. Much revenue was yielded from this activity as there was subsidization from the government and price stabilization through the National Produce Marketing Board (NPMB), which was in charge of coffee commercialization and provision of farm inputs at moderate prices. Farmers received farm inputs through their Cooperative Societies which existed in most of the villages in Noni Sub-Division under the Nso Cooperative Union. Because of this, much care was given to coffee sector and farmers were encouraged to grow more coffee. The demand for coffee in the world market was high and as a result, coffee output increased (Table 2). Thus, the trend of production during this period shows a steady increase with slight differences observed among the various villages with Djottin having a higher production rate than Lassin. However, a slight drop was witnessed in 1972 and this was due to pests and diseases which attacked coffee cherries in all the villages of Noni Sub Division that year, especially the Coffee Bearing Disease (CBD). After the 1972 attack on coffee cherries, there was the distribution of pesticides and fungicides by the government of Cameroon through the Nso Cooperative Union to farmers to fight against this CBD. As a result of this, coffee production picked up again and increased in 1973 and continued increasing to 1979.

Table 2: Coffee output in kg and tons in Noni from 1970-1979

| PRIMARY SOCIETIES | 1970   | 1971   | 1972   | 1973   | 1974   | 1975   | 1976   | 1977   | 1978   | 1979   |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Djottin           | 62102  | 63011  | 58300  | 60100  | 63200  | 65112  | 66602  | 68800  | 70130  | 73030  |
| Din               | 20320  | 20700  | 20100  | 20701  | 21212  | 21490  | 22809  | 23608  | 24199  | 28260  |
| Nkor              | 9208   | 9302   | 10020  | 10300  | 11211  | 13111  | 13300  | 14201  | 14918  | 15700  |
| Lassin            | 4319   | 4418   | 4130   | 4401   | 4920   | 5381   | 5419   | 5506   | 5710   | 6091   |
| Mbinon            | 44110  | 14201  | 14300  | 14720  | 15118  | 15216  | 15703  | 16200  | 16417  | 17712  |
| Dom               | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      |
| Total in kg       | 110059 | 111632 | 106850 | 110222 | 115661 | 120310 | 123833 | 128315 | 131294 | 140793 |
| Total in tons     | 110.1  | 111.6  | 106.9  | 110.2  | 115.7  | 120.3  | 123.8  | 128.3  | 131.3  | 140.8  |

Source: Oku Union and Noni Area Cooperative union archives (1990-1999)

The period 1980 to 1989 marked the formation of the Oku Noni Cooperative Union in 1982. Farm inputs especially fertilizers and pesticides were given to farmers at moderate prices through their Cooperative Societies. The application of pesticides reduced the rate of pests and diseases which attacked coffee while the application of fertilizers increased the soil fertility. There was also the introduction of the Java specie of Arabica coffee which was a High Yielding Variety to boost the output of famers. Because of these efforts, coffee output in this Sub Division increased (Table 3) but slightly lower than the previous period as a result of the economic crisis of 1986 which led to a slight decrease in the prices of coffee in the world market and a reduction in the government subsidies to farmers. The increase in coffee output from 1988 to 1989 was as a result of slight increase in the prices of coffee in the world market which encouraged coffee farmers to regenerate most of their farms.

Table 3: Coffee production in kilograms in Noni Sub Division from 1980-1989

| PRIMARY SOCIETIES | 1980   | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Djottin           | 36440  | 39779  | 39567  | 39800  | 41700  | 40860  | 44990  | 45234  | 46388  | 47994  |
| Fonti             | 38334  | 40201  | 38882  | 38811  | 34204  | 39912  | 42344  | 42527  | 42822  | 43888  |
| Din               | 29483  | 32100  | 32802  | 32703  | 34800  | 36503  | 37304  | 37800  | 38100  | 48728  |
| Nkor              | 16340  | 16500  | 17010  | 17400  | 17802  | 18300  | 19115  | 19339  | 19344  | 20112  |
| Lassin            | 6100   | 3617   | 4138   | 5608   | 6112   | 8908   | 10200  | 10833  | 11289  | 11838  |
| Mbinon            | 18101  | 18402  | 18618  | 17008  | 17061  | 18010  | 18800  | 18802  | 18872  | 19323  |
| Dom               | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      |
| Total in kg       | 144798 | 150599 | 151017 | 151330 | 151679 | 172493 | 172753 | 174535 | 176815 | 191883 |
| Total in tons     | 144.8  | 150.6  | 151    | 151.3  | 151.7  | 172.5  | 172.6  | 174.5  | 176.8  | 191.9  |

SOURCE: Oku Union and Noni Area Cooperative union archives (1990-1999)

The period between 1990 and 2015 saw the birth of the Noni Area Cooperative Union (NACU) in 1996 in Djottin. Coffee farmers in some villages within the Noni Sub Division boycotted the Union and continued with the Oku and Nso Union and some sold their coffee to licensed buying agents especially in Nkor, Lassin, Mbinon and Ndin. The trend in coffee production during this period was on a decrease with fluctuations in output within the years. The period between 1990 to 1999 was therefore considered as the worst period in the history of coffee production in Noni Sub Division. Farmers abandoned their coffee farms and cleared coffee stems in favour of the cultivation of food crops. There was the absence of farm inputs as the prices of coffee in the world market was very low as a result of the economic crisis. Coffee output fluctuated during this period with a decreasing trend (Table 4). The gradual rise in output in 1998 was ushered by the reorganization of Dim Cooperative Society.

Table 4.: Coffee production in kg in Noni Sub Division from 1990 to 1999

| PRIMARY SOCIETIES | 1990   | 1991   | 1992   | 1993   | 1994   | 1995   | 1996   | 1997  | 1998  | 1999  |
|-------------------|--------|--------|--------|--------|--------|--------|--------|-------|-------|-------|
| Djottin           | 50670  | 45894  | 41473  | 38913  | 40791  | 52890  | 39903  | 38471 | 34988 | 28512 |
| Fonti             | 45860  | 40675  | 32458  | 20941  | 23139  | 42295  | 30775  | 30028 | 27441 | 25182 |
| Din               | 40645  | 40589  | 38857  | 35841  | 34479  | 47895  | 46208  | -     | -     | -     |
| Nkor              | 24854  | 23445  | 15894  | 20456  | 19567  | 22865  | 14866  | -     | -     | -     |
| Lassin            | 17499  | 18945  | 16990  | 12980  | 14445  | 11059  | 4947   | -     | -     | -     |
| Mbinon            | 20556  | 22444  | 18964  | 15405  | 16404  | 19932  | 17135  | 5477  | 11660 | 9675  |
| Dom               | -      | -      | -      | -      | -      | -      | 4842   | 3587  | 2455  | 3330  |
| Total in kg       | 199814 | 191992 | 164636 | 144536 | 148825 | 196936 | 158676 | 77563 | 76544 | 96699 |
| Total in tons     | 199.8  | 191.9  | 164.6  | 144.5  | 144.9  | 196.9  | 158.7  | 77.6  | 76.5  | 96.7  |

Source: Oku Union and Noni Area Cooperative union archives (1990-1999)

The period between 2000 to 2015 marked the collapse of the Noni Area Cooperative Union in 2007. Before

the collapse, most of its members had withdrawn and started selling their coffee to buying agents and individual buyers. This was mainly because of the mismanagement of NACU. From 2003 to 2006 NACU had very few members as most of the farmers sold their coffee out of the Union. The Cooperative Societies were closed down and farmers took charge of the commercialization of their coffee produce. There was also the absence of farm inputs like fertilizers and pesticides. However, with the relaunch of coffee by the Cameroon government in 2008, OLAMCAM came to Noni Sub Division with the aim of educating and training farmers on the cultivation of coffee production increase. This organization also introduced high yielding variety of coffee known as the “java 2” which most of the farmers are planting now.

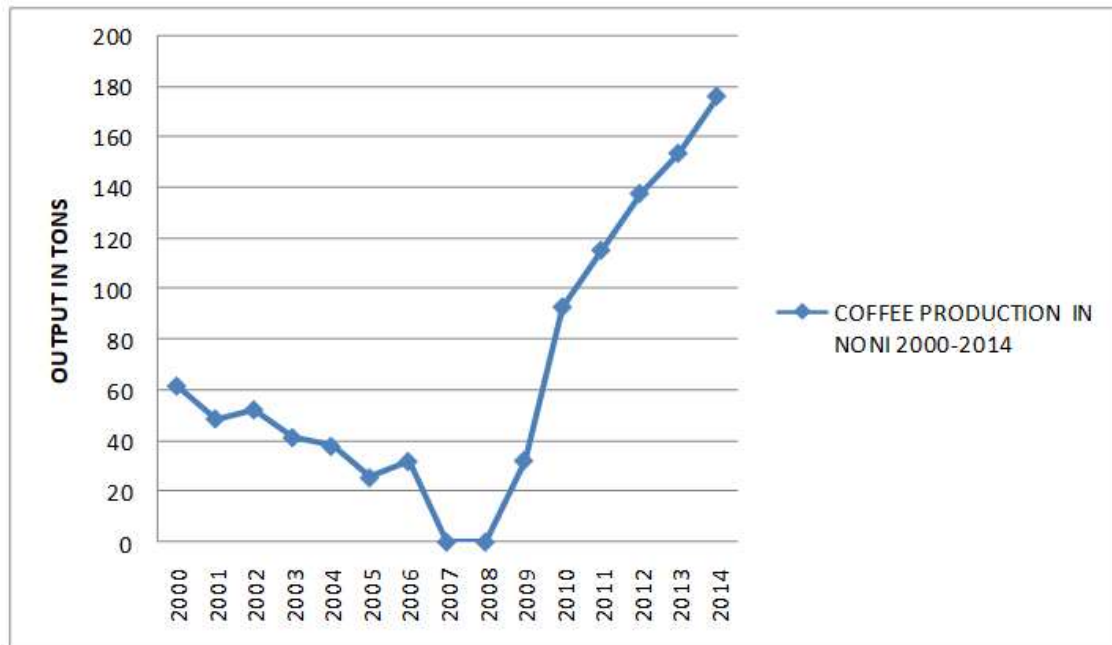


Fig 5: Trend in coffee production in Noni Sub Division from 2000 -2014

The graph shows a gradual decline from 2000 to 2008 due to the drop in coffee prices in the world market. From 2008, when world prices started rising again and with the coming of OLAMCAM, farmers were then encouraged to cultivate more coffee so as to meet up with the national target in the world market. The rapid growth in coffee production was equally necessitated by active regional participation of small and medium size enterprises which encouraged farmers to increase farm sizes as well as financial donations to farmers in order to control the spread of pests and diseases affecting coffee. Because of these measures, coffee output began to increase progressively from 2009 to 2015. As a result of the national interest on the coffee sector, the North West Cooperative Association (NWCA) saw it necessary to reorganize the defunct Cooperative Unions in North West Region so as to encourage farmers to cultivate coffee and equally belong to a particular Cooperative Society so as to benefit from the government grants. As a result of this, the defunct Noni Area Cooperation Union was reorganized in Djottin in June 2014.

#### Causes for the Fluctuation of Coffee Output

From the 1960s up to the early 1990s, the Cameroon government used institutions such as the Marketing Board and later Credit Agricole du Cameroun (C.A.C) to help stabilize coffee prices and give loans to farmers through Cooperative societies. The various periods in coffee production discussed above correspond to the period of fluctuating prices of coffee in the world market. Farmers are always encouraged by high prices offered for their product and these positively affect output. From 1986 after the economic crisis, prices of coffee in the world market dropped significantly and the impact was a drop in output. The situation became worse in the 1990s with the devaluation of the CFA and liberalization of the coffee sector and with the closing down of the National Producing Marketing Board (NPMB). Prices of coffee drastically dropped and affected output negatively. This drop in coffee production in 1990 continued till the year 2000. With the increase in the prices of coffee in 2006, coffee output also increased. This is confirmed by over 80% of the farmers interviewed who testified that the greatest problem faced in the coffee production is that of price. The table below shows fluctuations in coffee prices per kilogram of coffee from 1990 to 2014.



Table 5: Coffee price per kg from 1990 to 2014

| YEAR | PRICE | YEAR | PRICE | YEAR | PRICE | YEAR | PRICE | YEAR | PRICE |
|------|-------|------|-------|------|-------|------|-------|------|-------|
| 1990 | 300   | 1995 | 665   | 2000 | 400   | 2005 | 525   | 2010 | 1200  |
| 1991 | 275   | 1996 | 750   | 2001 | 300   | 2006 | 650   | 2011 | 1200  |
| 1992 | 275   | 1997 | 500   | 2002 | 475   | 2007 | 575   | 2012 | 1000  |
| 1993 | 275   | 1998 | 500   | 2003 | 395   | 2008 | 625   | 2013 | 1000  |
| 1994 | 500   | 1999 | 400   | 2004 | 375   | 2009 | 550   | 2014 | 1200  |

Source: Cameroon Coffee Development Strategy 2014

To show the relationship between coffee and prices in Noni, the Product Moment Correlation was used as shown on table 6.

The product moment correlation is calculated as

$$r = \frac{\sum xy/n - \bar{X} \cdot \bar{Y}}{S_x S_y}$$

Where r = the product moment correlation

X and y= the two variable prices and coffee

$\bar{X}$  and  $\bar{y}$  = the mean of the two variables

Sx and Sy = sample standard deviation of the variables

Table 6: Coffee prices and output from 1990 to 1999

| years | Price in CFA (X) | coffee in tons (Y) | X <sup>2</sup>       | Y <sup>2</sup>        | X                           |
|-------|------------------|--------------------|----------------------|-----------------------|-----------------------------|
| 1990  | 300              | 199.8              | 90,000               | 39920                 | 59940                       |
| 1991  | 275              | 192                | 25,625               | 36864                 | 52800                       |
| 1992  | 275              | 164.6              | 25,625               | 27093.2               | 45265                       |
| 1993  | 275              | 144.5              | 25,625               | 20880.3               | 39737.5                     |
| 1994  | 500              | 168.8              | 250,000              | 28493.4               | 84400                       |
| 1995  | 665              | 196.9              | 442,225              | 38769.6               | 130938.5                    |
| 1996  | 750              | 158.7              | 562,500              | 25185.7               | 119025                      |
| 1997  | 500              | 77.6               | 250,000              | 6021.8                | 38800                       |
| 1998  | 500              | 76.5               | 250,000              | 5852.3                | 38250                       |
| 1999  | 400              | 96.7               | 160,000              | 9350.9                | 38680                       |
|       | $\sum X = 4440$  | $\sum Y = 1476.3$  | $\sum X^2 = 2081600$ | $\sum Y^2 = 238431.2$ | $\sum XY = 647836$          |
|       | N=10             | N=10               | $\bar{X}^2 = 197136$ | $\bar{Y}^2 = 16281.8$ | $\bar{X} \bar{Y} = 56654.4$ |
|       | $\bar{X} = 444$  | $\bar{Y} = 127.6$  |                      |                       |                             |

$$S_x = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2} = \sqrt{\frac{2081600}{10} - 197136}$$

$$\sqrt{208160 - 197136} = 104.99$$

$$S_y = \sqrt{\sum \frac{y^2}{n} - \bar{y}^2} = \sqrt{\frac{238431.2 - 16281.8}{10}}$$

$$= \sqrt{23842.12 - 16281.8} = \sqrt{7561.31} = 86.96$$

$$r = \frac{\sum xy/n - \bar{X} \cdot \bar{Y}}{S_x S_y}$$

$$= \frac{647836}{10} - 56654.4$$

$$= \frac{104.99 \times 86.96}{8129.2}$$

$$= \frac{9129.9}{8129.2}$$

$$r = 0.89$$

The value 0.89 indicates a strong positive relationship between the two variables, that is, coffee and price. When prices are high, farmers are encouraged to cultivate more coffee which leads to high output in subsequent

years, whereas when prices drop farmers become discouraged to cultivate coffee and thereby leading to a drop in coffee production. Coffee price is therefore a strong motivating factor for coffee cultivation in Noni Sub Division.

Coffee cultivation, like other cash crops cultivation in Noni Sub-Division, requires a lot of close supervision and financial obligations. For a good harvest to be obtained, farmers need to constantly clear their farms, do proper pruning and spraying to control pests and eliminate the effects of coffee related diseases. Pruning tools, chemicals needed like Nordox 75mg for spraying coffee farms, harvesting of coffee and partial transformation activities are expensive. If these elements are not put in place even with a price increase in the world market, output will still be low. Another issue hindering production is the age of the stem. Most coffee farms in Noni Sub Division are over five decades old. Poor maintenance activities coupled with coffee related diseases significantly placed the sector in a very poor state. The absence of adequate knowledge on proper pruning mechanisms, poor periodic rejuvenation techniques, lack of disease resistant species further compound this trend. Most farmers are old and the energy required for proper crop management is largely absent. This has contributed to the declining state of the sector in the area.

Besides the old nature of most farms in Noni Sub Division, coffee related diseases have also contributed to the destruction of the coffee economy in certain areas like Nkor and Lassin. The most common type of pest in the area is the Coffee Stem Borers (CSB). This Coffee Berry Disease (CBD), is a major constraint for Arabica coffee cultivation in Africa. It causes the cherry to rot and premature fruit falls off leading to considerable harvest losses in the Noni Sub Division. It is also responsible for the destruction of many coffee stems.

When it affects the young cherries, they develop black spots and eventually fall off. Bees and butterflies destroy the flowering coffee plants. Bats and other rodents like squirrels and rats eat up the developed and ripened coffee cherries. The following table presents some of the different pests within the area and some possible best control measures which have been used with some degree of success.

Table 7: Pests, Description and Effects on Coffee plants in Noni

| PESTS                      | DESCRIPTION   | DAMAGE/EFFECTS   | BEST CONTROL  |
|----------------------------|---|--|---|
| Scales                     | Sap-sucking insects feeding on leaves and young twigs   | Reduced growth, black sooty mould on leaves, sweet excrement which attracts ants etc   | Removal of branches touching the ground, spray with mineral oils, carbaryl and tobacco water  |
| Mealy Bug                  | Small and whitish feeds on all green parts of the tree, mostly on flowers and young fruits  | Reduced vigor, yield loss and heavy honeydew production attracting enemies etc   | Removal of branches touching the ground, spray with mineral oils, carbaryl and tobacco water  |
| Stem Borer                 | Insects that lay eggs on the back, its larvae nestles inside the stem and eats its way creating a borehole or cavity              | Wilting of leaves, loss of branches, the whole plant can die if left unattended, yield falls   | Cut infected part of the plant just below last set of wilting, burn the cut part immediately, insert a thin metal wire into the borehole if found to kill the larvae                            |
| Coffee Berry Borer (CBB)   | Lays eggs on young green cherries, larvae feed on young beans, can be carried to next season through overripe and fallen cherries | Premature cherry drop, yield loss, infected cherries have a little hole on them  | Reduce heavy shades on the farm, prune the coffee to keep tree open, pick all fallen cherries from the ground, all infected cherries should be burnt, spraying is required                      |
| Nematodes                  | Soil-born pest, mostly invisible to the naked eye, they feed on sap from the roots  | Can cause fungal infection of the root system, in bad cases, tree can die off, reduced root development in nurseries etc                                   | Sterilize the soil during nursery, good pruning stimulates proper root development, use of nematicides such as oxamyl etc   |
| Coffee Leaf Rust (CLR)     | Fungal infection of leaves. CLR needs sufficient humidity and temperatures above 20°C to develop.                                 | Red rust patches on affected leaves which can result to leaf drop, reduced foliage limits photosynthesis and high yield loss.                              | Proper pruning helps limit CLR, spray copper-based fungicides: copper hydroxide and copper oxychloride can be used.   |
| Coffee Berry Disease (CBD) | It is a fungal infection of the coffee berries (see <b>plate XII</b> ). It appears as dark, sunken spots on premature cherries.   | Cherries become infected just after flowering and die on the tree leading to cherry fall. Up to 80% of potential yield can be lost if infection is severe. | Hard to control. Best resistant varieties such as Java have recently been introduced, farm hygiene is very essential, copper hydroxide and copper oxychloride can be used at very early stages. |

Source: Adapted from International Coffee Organization, 2015)

Climate is one of the most important factors favouring coffee production in Noni Sub-Division. Climatic elements like sunshine, temperature, rainfall and wind are all important for the growth, development and ripening of coffee cherries. Variations within the normal climate patterns affect coffee production leading to drop in output. Rainfall in mid February to mid March enhances flowering of coffee and as the rain progressively increases to August, young cherries are developed. Despite this condition, rain at times comes in mid February and ceases for the whole of March to May leading to the drying-off of the flower, thus altering normal cherry development. Also, when rain falls heavily in March accompanied by strong winds, coffee flowers are destroyed as testified by coffee farmers. Rainfall which is supposed to reduce by October for harvesting of coffee to take place, at times continuous up to November shattering ripe coffee ready for harvesting. High intensity of sun by April and May at times leads to the development and spread of Coffee Berry Borer (CBB) which further leads to premature cherry drop. Heavy rainfall and strong winds also enhance the spread of some pests and diseases. These factors account for the fluctuations in coffee production.

### **Socio -Economic Impacts of Coffee Cultivation**

The socio economic impacts of coffee production in the Noni Sub Division are many and cover domain: like employment, source of income, health and education, as well as infrastructural development. Coffee farming has created and still continues to offer job opportunities both at the villages and at the cooperative level. It offers self employment to farmers and provides indirect employment to the indigenes of the Noni Sub Division. Ageing coffee farmers cannot perform certain aspects of coffee farming such as clearing, harvesting, pulping and transportation. Field report shows that about 80 percent of the active population in the Noni Sub Division is directly and indirectly involved in coffee cultivation. Before the year 2006 when NACU collapsed, it had about 30 permanent workers and over 50 seasonal workers. Some of these workers are involved in nursery, selecting of the grains, weighing, bookkeeping and store keeping. With the reorganization of NACU in 2014 some of the Cooperatives were reorganized and so many people gained employment either with the Union or the subsidiary Cooperative Societies. By January 2015 the total number of permanent workers with the Union and cooperative societies was 25. From reports in the field, the number dropped with the drop in coffee prices.

Income from coffee production brings in revenue in the country at large and increases the per capita income of the farmers individually. Through oral discussion with some coffee farmers in Noni Sub Division, income from coffee sales is used to re-invest in other small scale businesses like operating a provision store, retailing some basic household necessities (palm oil and kerosene) and the rearing of animals like sheep, goats and cattle. The farmers are able to contribute for developmental projects such as water projects, infrastructural development like schools and houses. Also, information from the field revealed that in the past the coffee farmers operated a “coffee njangi” group. This was very instrumental as it enable coffee farmers to acquire finances for construction and other problems faced by the farmers. For instance, in the year 2012 coffee farmers earned between 120,000 and 300,000 FRS per month depending on the quantity produced and the cost of a kilogram of coffee in the world market. However, the income earned by coffee farmers in Noni Sub Division cannot be predicted since coffee prices are determined by forces of demand and supply in the world market. In the year 2006-2009 prices were encouraging between (550-650 FCFA per kkg) and from 2010-2014(1200-1000 FCFA/kg) for a kilogram of coffee. Farmers were highly encouraged as some opened new coffee farms and improved on their standard of living.

In spite of the fluctuating and the decline in coffee production, the coffee sector is still essential to the large coffee population in the Noni Sub Division as they depend on the income from the sale of their coffee for basic facilities like paying their medical bills and educating their children. In Noni Sub Division, nearly all the coffee farmers have been educating and are still educating their children from coffee income. In upper Noni, for example coffee is the main source of income. Hence, when coffee prices drop, farmers in Noni Sub Division face a lot of difficulties in settling school and medical bills for their children. This was the case in the 1990s in Din and Djottin where enrollment numbers of children sent to secondary school dropped. The situation improved in 2002 when coffee prices increased again. From a survey conducted on farmers about their income, it was revealed that education consumes up to 40% of the total coffee income and health 15%.

In the past, most farmers in the area lived in grass roofed houses which required periodic replacement of the roofs. Today, modern homes have been built and roofed with corrugated iron sheets. Unlike the grass roofed houses, the construction of modern homes helped the farmers to store their coffee safely from being soaked by rain during the wet season. In each of the six villages of the study area, there are self-reliant and development oriented authorities. These included: Djottin Area Development Authority (DADA), Din Development Authority (DDA), Nkor Development Authority (NDA), Lassin Development Authority (LADA) and Mbinon Development Authority (MBIDA). These groups hold their annual development meetings in December every year. This is a time when the bulk of coffee produce is harvested and sold. Coffee farmers therefore are viable enough to contribute in the different projects initiated by the development authorities. The importance of the coffee sector, as a source of livelihood therefore cannot be undermined as it plays a great role in the standard of living of the people.

## Conclusion

In the previous years, the coffee sector was very vital in the socio-economic development of the indigenes and most rural communities who depended on coffee to sustain their livelihood. There is the need for stakeholders to revamp and stabilize prices of coffee and the introduction of a processing unit will lead to development. Based on all the positive issues this sector brings to this area, workshops and seminars should be organised by the various stakeholders to educate farmers on good farming techniques and provide improved coffee seedlings. The government of Cameroon through the Ministry of Agriculture and Rural Development should encourage Agricultural Shows and prizes should be awarded to the best coffee producers, as this will help to promote high quality yields for farmers. The government should create processing plants to cope with domestic production and to reinforce her assistance to cooperatives. The prices of farm inputs should be subsidized and the government should review downwards the taxes for the importation of these farm inputs and make them more available and cheap to every farmer. Research activities should be encouraged through the provision of high yielding coffee varieties which are resistant to pest and diseases. Coffee farmers in Noni should be encouraged to join the cooperative societies in their various villages so as to be able to benefit from government grants to coffee farmers. If some of these recommendations are put in place, it will go a long way in improving the socio-economic development of this area and Cameroon as whole.

## References

- Adrianno, M. (2007): The Biogeography of coffee. Crabtree Publishing Company
- Agra-net. (2015). Outlook for the World Coffee Market 2014. *F.O. Licht Commodity Analysis*. Retrieved from <http://foodchemicalnews promo.agra-net.com/files/2015/02/World-Coffee-Market-2014-SAMPLE.pdf>
- Alon, Y. (2011): The Infinite Emotion of Coffee. Macchiatone Communication, LLC USA
- Arah, L. (2001): Coffee and Community. University Press of Colorado. pp1-18
- Baffes et al (2005): Coffee: market setting and policies in Global Agriculture, trade and developing countries. Washington Dc
- Benoit, D and Stefano, P. (2005): The coffee paradox, Global market commodity and elusive promise of development. London, UK
- Borém, F. M., Ribeiro, F. C., Figueiredo, L. P., Giomo, G. S., Fortunato, V. A., & Isquierdo, E. P. (2013). Evaluation of the sensory and color quality of coffee beans stored in hermetic packaging. *J of Stored Prod Res*, 52, 1-6. <https://doi.org/10.1016/j.jspr.2012.08.004>
- Brice R. Mbodian. (2014): Cameroon rescue effort for coffee. *Business in cameroon*, vol 3, No 14. pp14-15
- Cameroon poverty Reduction strategy paper (August 2003): International monetary fund report NO. 03/249. Pp 5-30
- Cameroon Coffee Development Strategy (CCSDSP). (2008-2015) of MINCOMERCE, MINADER, MINAPAT, National cocoa and coffee inter professional Board. PP 1-58
- Cardenas, M. (1994): Sustainable and Redistribution of coffee Revenue: A political Economy model of commodity marketing Board. *Journal of Development Economies*:44: 351- 380
- Corby, K. (2003): The joy of coffee; the essential guide to buying, brewing and enjoying. Houghton Mifflin Company, New York. P18
- Damatta FM, Ramalho JDC (2006). Impacts of drought and temperature stress on coffee physiology and production: a review. *Braz. J. Plant Physiol.* 18:55-81.
- Davis AP, Gole TW, Baena S, Moat J (2012). The impact of climate change on indigenous arabica coffee (*Coffea arabica*): predicting future trends and identifying priorities. *PLoS One* 7(11):e47981.
- Eka Terina, K. (2007): Three essay on coffee market. PhD Thesis In Agriculture and Resource Economics, Department of Agriculture and resource management economy, graduate school the University of Merry Land U.S.A
- Fassio, L. O., Malta, M. R., Carvalho, G. R., Liska, G. R., Lima, P. M., & Pimenta, C. J. (2016). Sensory description of cultivars (*Coffea Arabica* L.) resistant to rust and its correlation with caffeine, trigonelline, and chlorogenic acid compounds. *Beverages*, 2, 2-12. <https://doi.org/10.3390/beverages2010001>
- Figueiredo, L. P., Borém, F. M., Ribeiro, F. C., Giomo, G. S., Taveira, J. H. S., & Malta, M. R. (2015). Fatty acids profile and parameters of quality of specialty coffee produced in different Brazilian regions. *African J of Agric Res*, 10, 3484-3493. <https://doi.org/10.5897/AJAR2015.9697>
- Folmer B (2014). How can science help to create new value in coffee? *Food Res. Int.* 63:477-482
- Gilbet C L, Tollens E, Nchare A, Kamanjou F (1999): "Impact of economic liberalization in Cameroon's coffee and cocoa Sub Sector", Final Report for the European Commission Delegation; Department of Finance, Free University of Amstardan
- Hardings, P E. Bleeker, P. Frreyne D F. (1986): Land sustainability Evaluation for rain fed Arabica coffee industry, Western Highland Province. Coffee industry Cooperation, Papua New Guinea
- International Coffee Organization (ICO) (2017). Trade Statistics Tables. London, United Kingdom - 2017.

- Available at: [http://www.ico.org/trade\\_statistics.asp?section=Statistics](http://www.ico.org/trade_statistics.asp?section=Statistics).
- .International Coffee Organization. (2015). The Current State of the Global Coffee Trade. Retrieved from [http://www.ico.org/monthly\\_coffee\\_trade\\_stats.asp?section=Meetings](http://www.ico.org/monthly_coffee_trade_stats.asp?section=Meetings)
- International Coffee Organsiation, 112th session (3-7 march 2014). London, United Kingdom. pp 1-29
- International Coffee Organization. (2011). *Volatility of Retail Prices of Roasted Coffee in Selected Countries*. Retrieved from <http://www.ico.org/presents/1011/icc-106-12- volatility.pdf>
- Iscaro J (2014). The Impact of climate change on coffee production in Colombia and Ethiopia. *Global Majority E-Journal*, 5(1):33-43
- Jaffe, D. (2007): *Brewing justice: Fair trade coffee, Sustainable and survival*. University of California Press, California
- Julie, F. (2009): *Coffee Wilt Disease*. Oxfordshire, UK
- Killeen JT, Harper G (2016). Coffee in the 21st century. Will Climate Change and Increased Demand Lead to New Deforestation?
- Kuhlin, J and Modig, A. (2009): Poor African coffee farmers: A study of the competition at Kenyan and Tanzanian coffee auctions. Master thesis. pp6
- Kuit Consultancy (December 2008): A base line study on the promotion of sustainable Arabica coffee production in North West region of Cameroon. pp 17-30
- Kuit Consultancy (May 2009): Pest and disease management; Promotion of sustainable Arabica coffee production in North West region of Cameroon. pp 3-25
- Kunle, E. D. (2010): The influence of technology on Gender Division of Labour in Household; the case of Wet Coffee post harvest Handling in Kasese Distric, Thesis
- Lingle, T. R. (2011). *The coffee cupper's handbook: Systematic guide to the sensory evaluation of coffee's flavor*(p. 66). Specialty Coffee Association of America, Long Beach
- MINAGRI, (2003): Rural Sector Development Strategy paper. Yaounde, Cameroon
- Nchare, A. (2007): "Analysis of factors affecting technical efficiency of Arabica coffee production in Cameroon". Research paper 163, Africa economic research consortium, Nairobi
- Oku Union and Noni Area Cooperative union archives 1990-1999
- Ovalle-Rivera O, Läderach P, Bunn C, Obersteiner M , Schroth G (2015). Projected shifts in *Coffea arabica* suitability among major global producing regions due to climate change. *Plos One* 10(4):e0124155.
- Silva FC, da Silva FM, da Silva AC, de Barros MM, Palma MAZ (2013).Desempenho operacional da colheita mecanizada e seletiva do café em função da força de desprendimento dos frutos. *Coffee Sci. Lavras* 8(1):53-60
- Thurston, R. W., Morris, J., & Steiman, S. (Eds.). (2013). *Coffee: A Comprehensive Guide to the Bean, the Beverage, and the Industry*. Rowman & Littlefield Publishers
- Waller J, Bigger M, Hillocks R.(2007): *Coffee pest, diseases and their management*, Oxfordshire, UK
- Walter, M. (2007): *Coffee Pest, diseases and their management*, Oxfordshire, UK
- William, G and Steven, T. (2003): *The Global economy in Africa, Asia and Latin America*. Cambridge University Press, New York, USA