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# Investigation of the effects of rainfall (Climate Change) on pineapple production in Essequibo Tri-Lakes Area

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## *Abstract*

*The variability of the rainfall pattern on the Essequibo Coast can be seen as an agricultural risk. Indigenous and other farmers who produce pineapple in the area operate using an organic methodology, having been certified with the assistance of IICA, and have been traditionally relying on rain-fed conditions to satisfy the moisture requirements of the crops. Since the Essequibo Coast normally experiences two rainy periods on an annual basis, the pineapple farmers have depended upon and used this as a source of water for their cultivation methods. Moisture availability is important to the pineapple plant at critical periods of growth of the crop and deficits or excesses can have detrimental effects on production.*

*This situation was evident owing to the fact that pineapple yields were substandard for a two-harvest period and the crops produced were not accepted for processing by the Mainstay Pineapple Factory, as the fruit from these crops did not satisfy the criteria for processing. The Mainstay Pineapple Factory which depends on local pineapples from the area was not able to satisfy its AMCAR export market to Europe and other countries. The pineapple factory lost important revenue and if the phenomenon continues, it risks losing its market share and foreign exchange income.*

*During the period of review, the rainfall experienced was out of sync with the normal rainfall pattern with moisture not being available at the critical periods as needed for the maturity of the crop. This abnormal pattern of rainfall was to the detriment of two successive pineapple crops. The fruits produced were smaller and cores larger, being unfit for processing by the factory's standards. The study reveals that even though there was the production of a smaller crop, the fruits were substandard relative to processing criteria. The reasons were that the rains were not enough during the vegetative state of the pineapple growth, triggering early flowering, just after which the rains came and there was too much water available, leading to vigorous stem growth and large core development which is disadvantageous when the fruit is used for canning.*

Keywords: *Climate Change, Rainfall, Pineapple Processing, Agricultural Risk*

## Introduction

Irregular rainfall patterns in the Tri-Lakes area on the Essequibo Coast of Guyana have affected value added pineapple production. Even though the Tri-Lakes area is noted for its tourist attractions, pristine forests and lakes, it also has an agro-forestry activity of organic pineapple production which is quite popular. Forests are defined by the FAO as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10% or trees with the ability to reach these thresholds "*in situ*"[1]. Much of the area in the Tri-Lakes vicinity has been untouched by any economic activity. Tourism is further being developed using an Eco-Friendly approach. As a means of diversification of possible income generation, and also to assist in the development of this rural area, farmers in the Mainstay, Whyaka,

[1] Farming Change; growing more food with a changing resource base: critical issues, perspectives and options / IICA, CARDI, CTA and POS, Trinidad and Tobago: CaRAPH, 2012.

Capoey and Tapakuma areas on the Essequibo Coast were organized into groups to be associated with pineapple production. With the availability of large acreages of virgin forests and the methodology of slash and burn, it was easy for the existing indigenous farmers to adopt an organic cultivation of pineapple approach. From 2007–2008, with the support of the Inter-American Institute for Cooperation on Agriculture (IICA), these farmers were updated on the protocols necessary for certification and fields were visited and certification granted for this Agro-forestry activity in this environment. They have continued with the support of IICA with their cultivations of simple slash and burn with no commercial soil ameliorants or pesticides. They were trained to maintain soil fertility through composting and fallowing practices.

Many of the farmers, comprising a relatively high number of females, do not have secondary education and are peasants relying on the forest-farms under rain-fed conditions for an income. Income from the pineapple crop is accrued bi-annually in the months of May and October. Farmers depend upon these monies to partially supplement their livelihoods. There are other activities of income generation, of which cassava production on a small-scale for cassava bread production and logging are being done.

Farmers have two options for the sale of their pineapple crops; the first option is that the pineapples may be purchased by the Mainstay Pineapple Factory for the Amazon Caribbean (AMCAR) Market - an export market. The second option, entails selling the pineapple to hucksters or who visit the farm directly to consumers at the Anna Regina Market. It must be noted that less costs are incurred to the farmer if the pineapples are sold to the Factory, since it is in close proximity to the organic farms and the factory provides a service of collection of the produce from the farms. If not sold to the factory, there is an added transportation cost and higher post-harvest losses, since fruit damage occurs as a result of additional handling during transport from the farm to the Anna Regina Market.

As part of their cultivation strategy, farmers have been traditionally patterning their modes and time of planting and have become accustomed to the “normal” seasonal rainfall patterns. Traditionally, their agronomic actions were in balance with nature. However, with the advent of Climate Change patterns, there appears an out of sync action between cultivation and production of pineapples relative to the rainfall patterns. This has resulted in fruit of a substandard level deemed undesirable by the factory for processing, creating an agricultural risk through the loss of income and markets for both the organic pineapple farmer and the Mainstay Pineapple Factory.

## Materials and methods

The methodology for this study involved two modes. Firstly desk study of the Climate Change literature and results, structured interviews with pineapple farmers, vendors and the Manager of the Lake Mainstay Pineapple Factory. Discussions were also held with the Village Captains of the respective Communities as well as non-pineapple farmers.

The task involved travel to the communities of Capoey, Mainstay and Tapakuma Villages where the Organic Farms are located, followed by a visit to the Anna Regina Market on the Essequibo Coast. Visits to the farms also confirmed the modality of cultivation and identified the shortfall in the productive capacities of the fields planted at that time.

The farmers and vendors were informed to obtain a situation analysis. On the day of the visit to the Anna Regina Market, there were only ten farmers who were also vendors that were selling smaller sized pineapples that were rejected by the Pineapple Factory.

Three Captains and ten farmers were interviewed, representing the total number of farmers in the village of Mainstay. There is a total of twenty-one (21) registered farmers, but approximately sixteen (16) are actively farming. Mr. Joel Fredericks, Captain of

Mainstay Village who is also the Manager of the Pineapple Factory, provided a perspective of the shortfall of production as a result of the sporadic and out of sync variation from the normal rainfall in the area and which was responsible for inhibiting the usual high quality fruit demanded by the factory.

Data on rainfall was also collected and means-of-periods of ten years analyzed to identify rainfall trends which were perceived as “normal rainfall”. A comparative analysis of the “normal” and the period of review was then done so as to identify a situation that could be termed an out of sync rainfall pattern as attributed to climate change.

**Results and Discussion**:

Figures 1 to 5 show monthly mean rainfall occurring on coastal Guyana during the period 1956-2010. These graphs indicate a trend relative to the “normal pattern” of rainfall. According to the Meteorological Department of the Ministry of Agriculture, Guyana has a tropical climate, with little seasonal temperature change. The annual rainfall (about 1525 to 2030 mm/about 60 to 80 in) on the coast occurs mainly from April to August and November to January. The savannah region receives some 1525 mm (some 60 in) of rain annually, mainly from April to September. Traditionally, Guyana experiences two distinct wet seasons and two dry seasons. Seasonal rainfall variability is generally the dominant characteristic of climate in Guyana. The annual rainfall distribution of coastal Guyana shows a bi-modal pattern. This is as a result of the annual meridional migration of the Inter Tropical Convergence Zone (ITCZ). The northward movement of the ITCZ generally brings heavy rainfall between mid-April and the ending of July, with major rainfall in June. This is referred to as the primary wet season. During southward migration of the ITCZ, a second wet season is observed between mid-November and the ending of January with peak rainfall in December. The periods in between are often referred to as primary dry (long) season and secondary dry? (short) season respectively. During the period 2011 to 2012, there appeared changes in the rainfall patterns. These changes are evident in the rainfall data collected from the meteorological station at St. Deny’s, which is located in the vicinity of the Tri-Lakes area. Figure 6 indicates the precipitation for those years. Evident is the increased volume of the rain and also the deviation from the normal trend that existed since 1956.

Figure 7 further shows a differentiation from the trend, illustrating a steep increase in total rainfall. In reviewing both years, there is much disparity in the rainfall. Except for the month of September, all other months showed dramatic differences between 2011 and 2012.

Farmers complained about the harsh conditions during the growth of the crop, indicating that there were very dry conditions during the vegetative stage of the crop. This is very evident in the month of April 2011 when there was less than the 50 mm rainfall. Mean rainfall for this month is usually above 100 mm. Since pineapples also have ratoon crops and the duration for production of fruit is between 12-14 months, moisture availability in the form of deficits one year can impact negatively on production in the next year’s harvests.

Climate change is perhaps the most serious environmental threat mainly through its impact on agricultural productivity (Anselm A. Enete and Taofeeq A. Amusa 2010). Climate change has been affecting agriculture and can pose an agricultural risk especially for smaller farmers. Changes in the frequency and severity of droughts and floods could pose challenges for farmers and ranchers[2]. These effects arise from the differences in the occurrences of the weather patterns from the normal. Climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other indicators. Climate change can involve both changes in average conditions and changes in variability,

[2] EPA (US). 2013. Agriculture and Food Supply Impacts & Adaptation – Climate impacts on agriculture need to standardize font/size in footnotes

including, for example, extreme events. In addition, the farmers are slow in changing their farming practices such as bush burning, deforestation and rain-fed agriculture and they lack the requisite education, information and training necessary to adapt to climate change. (Anselm A. Enete and Taofeeq A. Amusa 2010). Different crops need different environmental conditions to adequately grow and produce fruit. A fruit tree will normally begin to bear fruit after it has become old enough to blossom freely. Nevertheless, the health of the tree and its environment, its fruiting habits and the cultural practices used can influence its ability to produce fruit (Edmond Marrotte, undated). Inadequate conditions, either too much moisture or too little moisture, can have ill effects on production. Too little moisture can have moisture stress consequences to the plant, while too much moisture can increase the chances of diseases especially in a hot humid environment as exists in the tropics. Irrigation is an important buffer against climate variability and climate change (Cynthia Rosenzweig and Diana Liverman 1992).

The phenology of the pineapple consists of at least three critical stages. These are as follows: Vegetative stage, flowering and yield formation. At each stage, the requirements of moisture are different for optimal pineapple fruiting.

In the vegetative stage, moisture is required as it is here when the size and fruiting characteristics are determined. Any water deficits at this point will retard growth, flowering and fruiting. Thus water supply here must meet the full requirements of the crop.

Pineapple is usually grown in double rows on raised beds. With a spacing of 0.6 x 0.3m in beds 0.75 to 0.90m apart, plant population is about 50000 per ha.

In the Mainstay Tri-Lakes Area, most of the farmers have traditionally been growing pineapple and now have adopted the organic standards for planting. This area is found on the Essequibo Coast inland from the Coastal Main Road. It is accessible by trail and in relation to Capoey Village, by boat across the Capoey Lake. Pineapple farms are usually created out of the forests through the slash and burn technology, and generally are located at some distance away from the residences. The soil type for cultivation is predominantly Twiwid (white) sand, an extremely poor medium for plant growth (Chesney 1998).

Traditional farmers have to a major extent scheduled their activities of planting and harvesting so as to accommodate these normal seasonal variations in the rainfall pattern. Thus any seasonal changes of rainfall out of the ordinary will be challenging.

In the 2011–2012 crop seasons for pineapple, the harvest, even though of economic value, was of a poorer quality than normal. Even though there were fruits produced, the volume of production was considerably lower and fruits smaller with larger cores. The cores tended to be more fibrous and less palatable. Fruit quality was lower as the fruit had larger cores.

Pineapple can survive long dry periods through its ability to retain water in the leaves which is used during these periods. The pineapple plant has very low transpiration because it closes its stomata during the day and opens them during the night. Therefore, the majority of moisture loss associated with pineapple is evaporation from the soil. (FAO 2009). Also due to its low water use, the plant can survive on a small depth of stored soil water. However, the crop is sensitive to water deficit, especially during the vegetative growth period, when the size and fruiting characteristics are determined. *Water deficits retard growth, flowering and fruiting*. *Water supply during this period should meet full water requirements of the crop.* Water deficit at flowering has a less serious effect and may even hasten fruiting and result in non-uniform ripening. An ample water supply at flowering will lead to vigorous stem growth and a large core which is disadvantageous when the fruit is used for canning since the core becomes a fleshy rachis of the spike, often is fibrous and unpalatable[3].

Frequent irrigation or rain at the time of

[3] http://www.fruit-crops/pineapple-ananas-comosus

harvest may cause deterioration of the quality of the fruit and make the crop susceptible to the fungus causing heart rot. In addition, waterlogging affects fruit quality.

Where water supply is limited, mulching is practiced to reduce soil evaporation and soil temperature. Dew has been found to contribute to meeting the water requirements of the crop. (FAO 2013).

**Conclusion**

This investigation identified that even though there were rains in the location, the rainfall distribution pattern for the Mainstay Tri-Lakes Area on the Essequibo Coast was abnormal. The pineapple crop suffered since precipitation was not at the critical periods of crop growth. Since the soils in the area are sandy, much of the water runs off leaving very little for the biological processing of the plant.

Local organic pineapple farmers did not suffer in the short run, for they opted for the disposal of their produce where there was an alternative demand and income. This showed the resourcefulness of the farmers. Farmers took this recourse as the requirements for the export market are more complex for them as the requirements of the Factory were higher than those for the local fresh fruit market. Farmers had comparatively little economic losses in the short run even though the factory refused to take the crop.

However, on the negative side, the out-of-sync rainfall affected the community as the potential for foreign exchange that the factory could have realized was lost. For optimum production, the recommendation is to match the moisture needs of the crop as far as possible with moisture availability.

**References**

Anselm A. Enete and Amusa A. Taofeeq. 2010. Volume 4. *Challenges of Agricultural Adaptation to Climate Change in Nigeria*: a Synthesis from the Literature

Bartholomew, D.P., R.E. Paull, and K.G. Rohrbach. 2003. *The pineapple: botany, production and uses,* edited by D.P. Bartholomew, R.E. Paull, and K.G. Rohrbach, 1-301. Wallingford, UK: CABI Publishing.

CaRAPH. 2012. Farming Change; growing more food with a changing resource base: critical issues, perspectives and options / IICA, CARDI, CTA and POS, Trinidad and Tobago

Chesney P. 1998. Pineapple Germplasm Resources in Guyana, IICA/NARI

Edmond L. Marrotte, (Undated). *Why Fruit Trees fail to bear – Fact Sheet*, Department of Plant Science, University of Connecticut and USDA Leaflet No. 172

EPA (US). 2013. Agriculture and Food Supply Impacts & Adaptation – Climate impacts on agriculture

FAO. 2013. Crop Water Information: Pineapple, Natural Resources and Environment Department

FAO STAT. 2012.

Haws, L.D., H. Inoue, A. Tanaka, and S. Yoshida. 1983. “Comparison of crop productivity in the tropics and temperate zone.” In *Potential Productivity of Field Crops Under Different Environments International Rice Research Institute*. Los Banos, Philippines. pp. 403-413.

Http://www.fruit-crops.com/pineapple-ananas-comosus

**Coastal Rainfall (Guyana) 1956 – 2010**

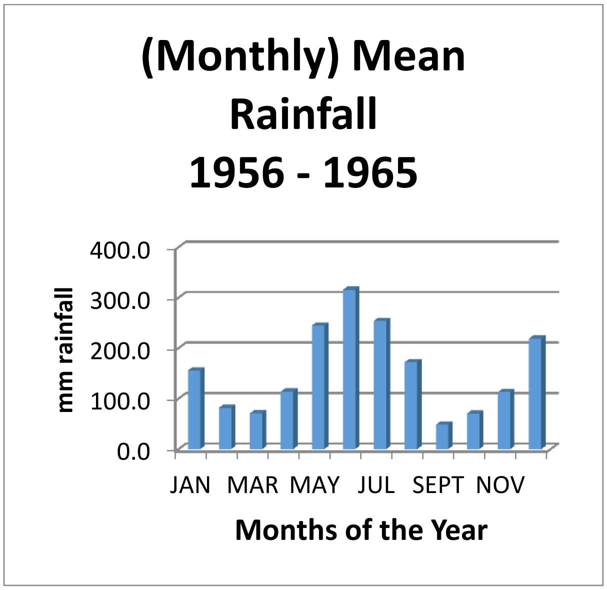


**Figure 1: Monthly Mean Rainfall 1956-1965**

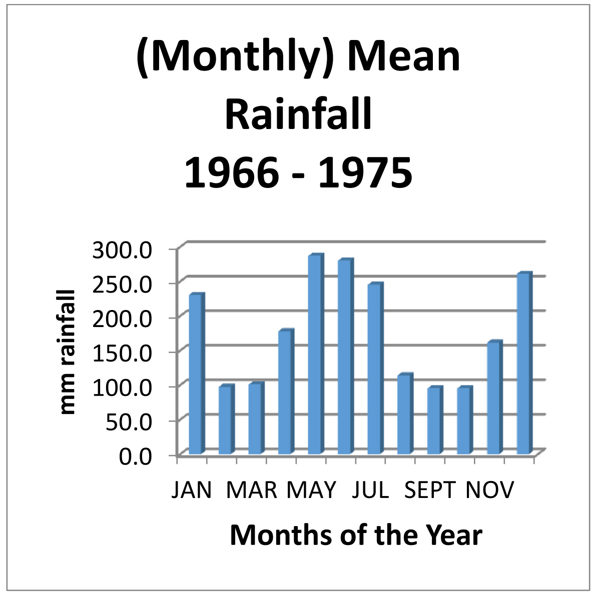


**Figure 2 :Monthly Mean Rainfall 1966-1975**

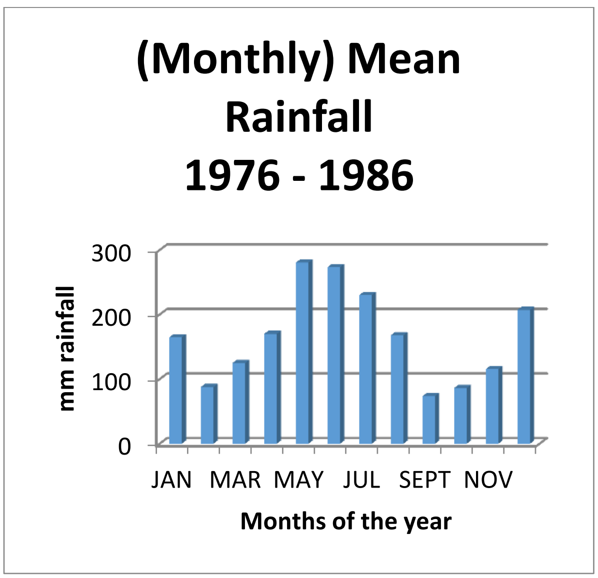


**Figure 3: Monthly Mean Rainfall 1976-1986**

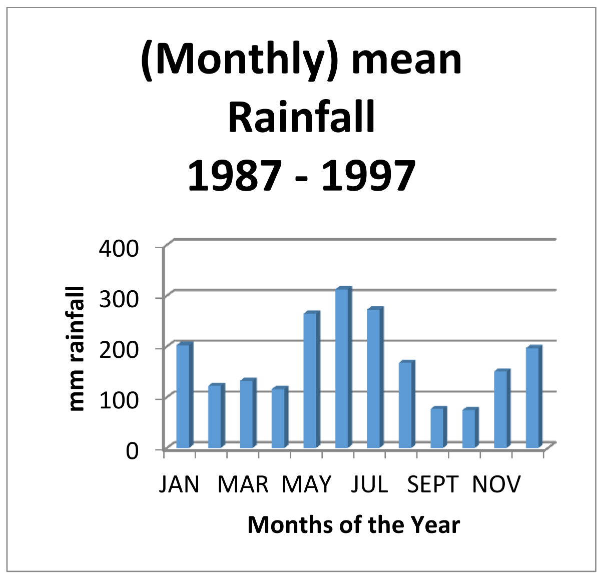


**Figure 4: Monthly Mean Rainfall 1987-1997**

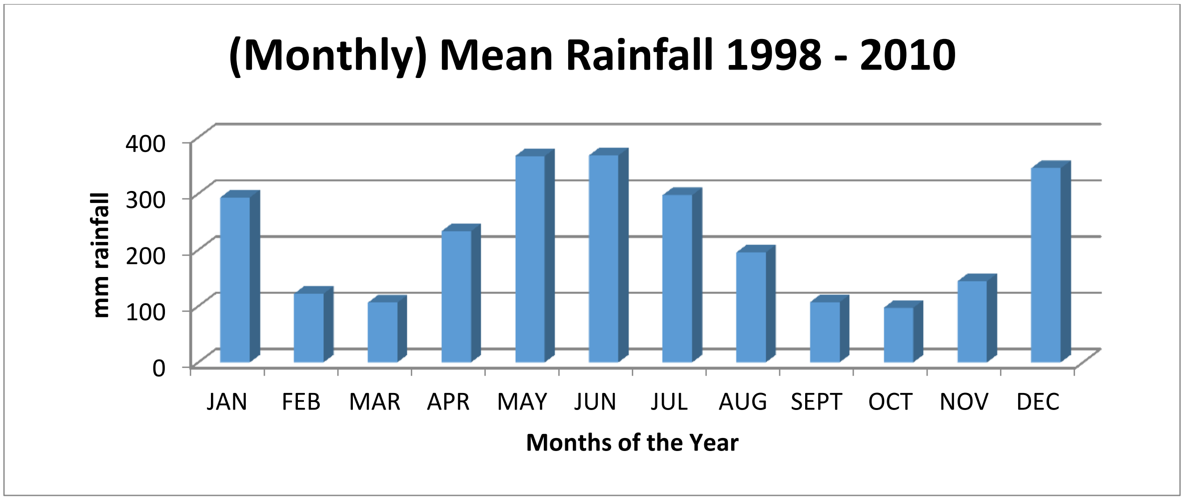


**Figure 5: Monthly Mean Rainfall 1998-2010**

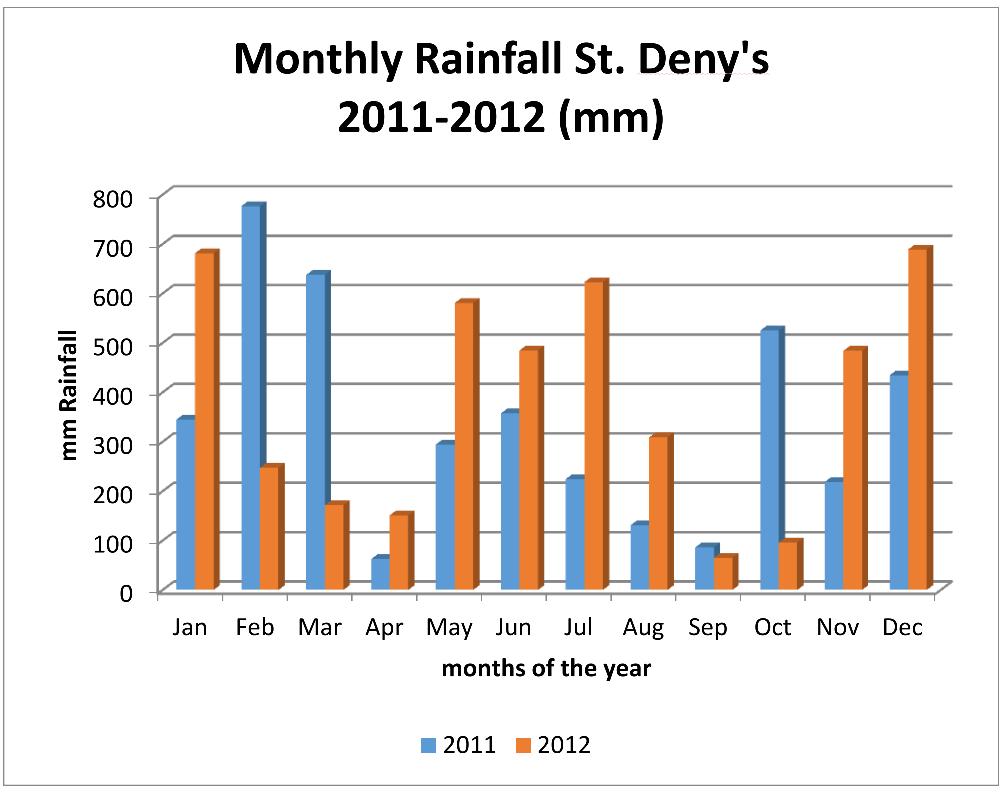


**Figure 6: Monthly Rainfall St. Deny's 2011-2012**

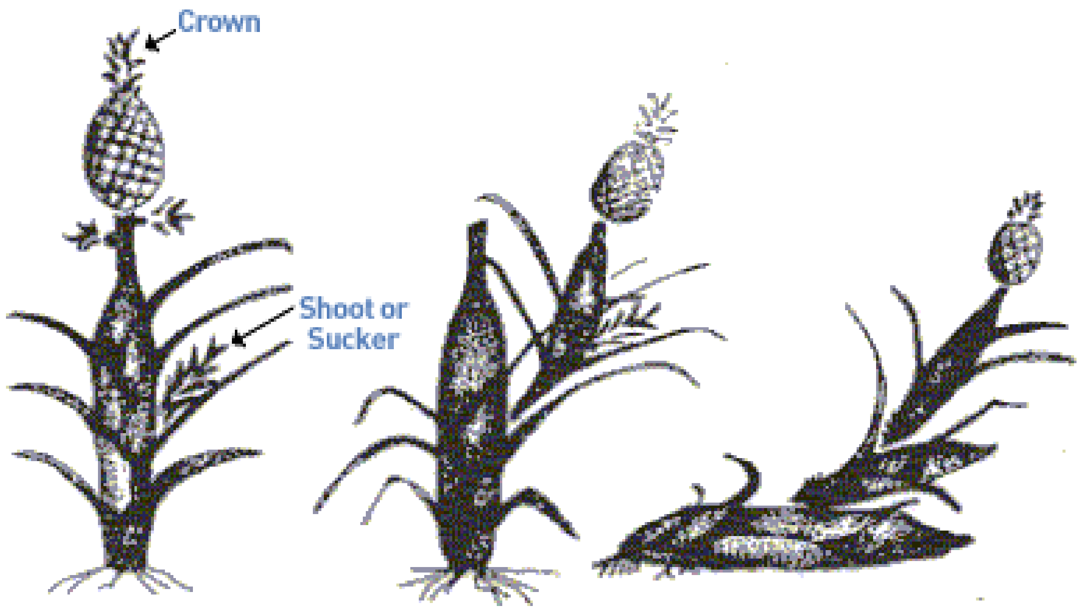


**Figure 8: Plant crop, first ratoon and second ratoon (Collins, 1960)**

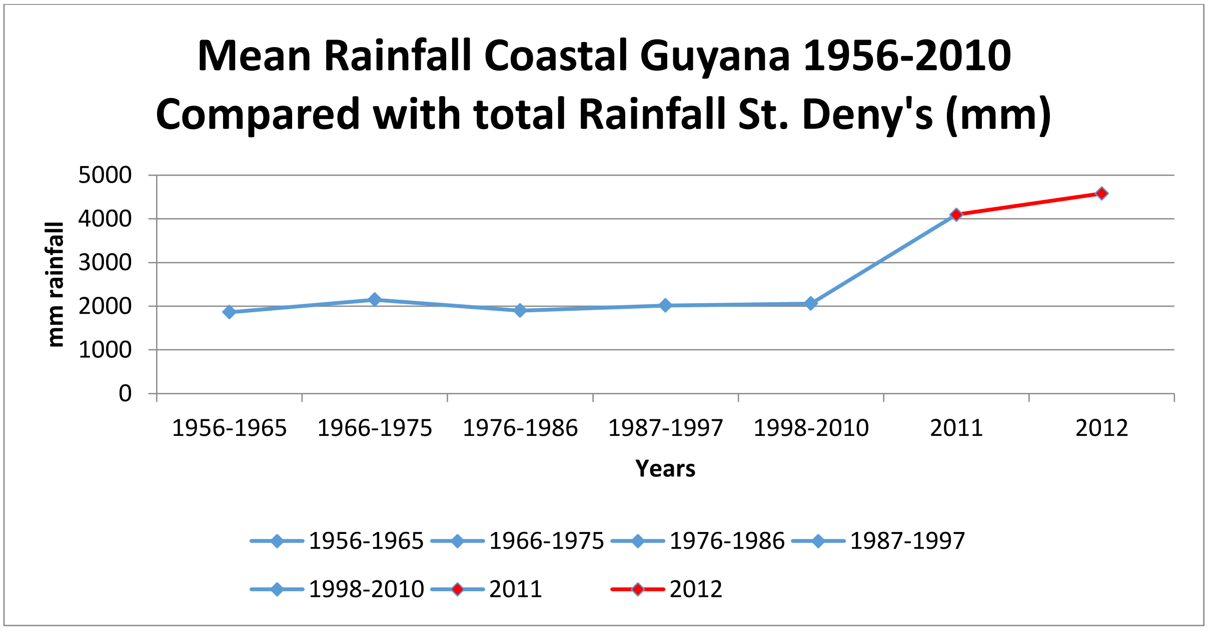


**Figure 7: Mean Rainfall Coastal Guyana 1956-2010 Compared with Actual Rainfall at St. Deny's 2011-2012**

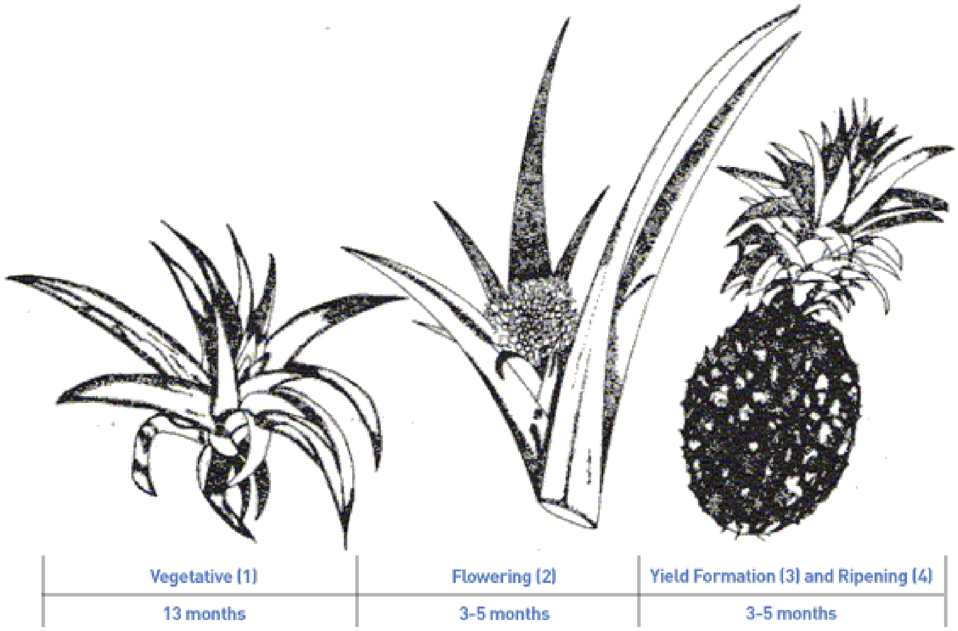


**Figure 9: Phenological stages of pineapple**