CHAPTER 3

THE TEA INDUSTRY IN MALAYSIA

The study aims to forecast tea production. It is therefore important to understand the factors that underlie the observed patterns and fluctuations in tea production. This chapter presents various aspects of tea production in Peninsular that will help shed light on this issue. The first section is a discussion on the varieties of tea, the origin and varieties planted in the country. The second section is a discussion on the trends in tea production in Peninsular Malaysia. The third section reviews the literature on factors affecting the yield before considering the Malaysian situation. The chapter concludes with a summary of patterns that can be expected in the yield series of tea in Peninsular Malaysia.

3.1 Tea Varieties

Tea is made from the young leaves and the unopened leaf buds that are plucked off the tea plant, botanically known as *Camellia Sinensis*. According to Harler (1966), cultivated tea falls into three groups or sub-species of Camellia Sinensis. These three main varieties of tea are classified according to the region of origin, namely China, Assam and Cambodia. The Chinese variety possesses small leaves, ranging from 3.8 to 6.4 cm long and the shrubs can attain a height of more than two meters. Assam tea bears larger leaves of up to 36 cm and the tea plant can grow up to a height of 18 meters if not pruned. Tea plants have an economic life of more than 40 years with regular pruning and plucking, the frequency of which varies with the variety. According to Williams (1975), tea cultivated at high elevations with mean maximum temperature of 25° C is known as highland tea, whereas tea cultivated at lowlands with mean maximum temperature of 32 °C is considered lowland tea.

In terms of produced tea, there are three basic types: black tea, green tea and oolong tea. Black tea is tea which has been fully oxidised or fermented and yields a hearty-flavoured, amber brew. Green tea skips the oxidising step. It has a more delicate taste and it is light green or golden in colour. Oolong tea is partly oxidised and is a cross between black and green tea in colour and taste. In this study, tea or made tea stands for manufactured dry leaf either in the form of black or green tea.

According to Deanna (1982), " The earliest mention of commercial tea in Peninsular Malaysia was at the beginning of seventeenth century when Terixeira met with it in Malacca." The first tea planted in Singapore and Penang came from China. Although it was believed that these tea plants seeded and reproduced freely, nothing was heard about tea until after the founding of the Singapore Botanic Garden in 1822, when the bush was brought in again from China and Assam and distributed in various parts of the country. In 1893 tea was said to be cultivated in a few places in Peninsular Malaysia, the largest estates being at Batu Pahat, Johore and at Cicely Estate, Perak.

The suitability of Malaysia's climate to rubber growing and the fact that rubber fetched high prices, caused a steady increase in the area planted with rubber until it dominated at the expense of all the other less profitable plantation crops. When the rubber market became saturated and prices fell drastically, the planters started to look around for crops that might tide them over the period of depression and crops such as tea and oil palm were considered. In 1925, the Department of Agriculture established about two hectares of tea at Serdang using tea seeds imported from India. John Archibald Russell started the first highland tea plantation in Malaysia in 1929 in Cameron Highlands and from then on the area under tea steadily increased until World War II broke out.

A tea survey carried out in 1960 found that the major lowland tea estates in Peninsular Malaysia were planted with Dangri (Dark leaf Manipuri) and other mixed Assam/Manipuri varieties and the highland tea estates were planted with Rajghur (Assam/Manipuri hybrid) and Betjam Assam varieties. Rajghur was considered the most promising variety both in terms of productivity as well as quality under the Cameron Highlands conditions. In fact, these were some of the higher yielding varieties among the other varieties experimented in Tanah Rata and Serdang Experimental Stations, Deanna (1981). Over the years there was no major replanting but newly developed areas were planted with top quality clonal varieties renowed for their robust and brisk character as well as high yielders. Bushes that were destroyed were also replaced by clonal varieties. Tea plants that were planted in the late twenties are still in production and yielding well[1]. Boh Tea Plantations state in their brochure that at Boh estates, the Assam varieties of Manipuri and Rajghur as well as clonal varieties are cultivated.

3.2 Trends In Tea Production In Peninsular Malaysia

Tea in Peninsular Malaysia is planted in two areas, that is the highlands and the lowlands. In 1940 the area under highland tea was 2012 hectares and that under lowland tea was 1592 hectares, giving a total of 3604 hectares. The total production of tea in 1940 was 741.8 tonnes of which 402.5 tonnes was from the highlands and remaining 339.3 tonnes from the lowlands. Table 3.1 shows the percentage of lowland and highland planted areas, average hectereage in production and production of made tea. The total hectareage planted with lowland tea has reduced from 41 percent in 1963 to 17 percent in 1995 whereas the total hectareage planted with highland tea has increased from 56 percent in 1963 to 82 percent in 1995.

In the early sixties about 40 percent of the total production of made tea was from the lowlands and 60 percent from highlands. During the seventies, lowland tea production was decreasing whereas highland tea production saw an increase. In the early eighties, there was about 18 percent lowland tea and 82 percent highland tea in the total production. In the early nineties, production of made tea consisted of 10 percent lowland tea and 90 percent highland tea but in the mid-nineties the

[1] Personal Interviews with managers from some major tea estates in Cameron Highlands

production of lowland made tea shows an increase. This is because the total production of tea or made tea is based on Malaysia not Peninsular Malaysia, as other areas planted in Malaysia are basically lowland tea.

Table 3.1: Percentage Breakdown Of Lowland And Highland Tea For Total Area Planted, Average Hectareage In Production And Production Made Tea In Peninsular Malaysia.

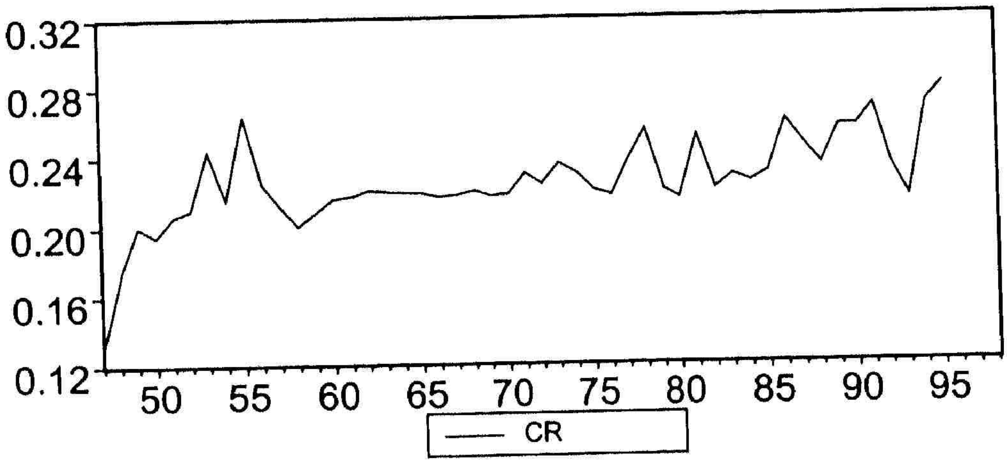
Year	Total Area planted (L)	Total Area planted (H)	Avg Hect in Prod (L)	Avg Hect in Prod (H)	Prod made tea (L)	Prod made tea (H)
1963	41	59	NA	NA	44	56
1966	34	66	37	63	47	53
1969	28	72	29	71	40	60
1972	24	76	26	74	35	65
1974	23	77	25	75	28	72
1980	17	83	17	83	18	82
1990	18	82	17	83	14	86
1992*	17	83	17	83	10	90
1995*	17	83	21	79	18	82

Data Source: Cocoa, Coconut and Tea Statistics Handbook Department of Statistics of Malaysia.
L: LOWLAND H: HIGHLAND
*Production for Malaysia: Includes Sabah and Sawarak

But, this increase is small and does not affect the trend of lowland and highland tea in Peninsular Malaysia. The trend indicates that over the years a high percentage of tea planted and produced in Peninsular Malaysia comes from highland plantations. Since highland tea production is subject to climatic conditions, increasing fluctuations can be expected in the production or yield series over this period.

Tea is produced from green leaves. Figure 3.1 shows annual ratio of made tea to green leaves from 1946 to 1996. After 1970 there is an increasing fluctuation compared to previous years where the rate was constant. This could be because of high "off grades" due to mechanised plucking. Before 1970 the hand-plucking method was used as this method gives the best quality leaf with minimal "off grade". The average conversion rate for Peninsular Malaysia over the period of 1947 to 1996 is 22.5 percent. The trend indicates that conversion rate can be considered stable or constant over this period.

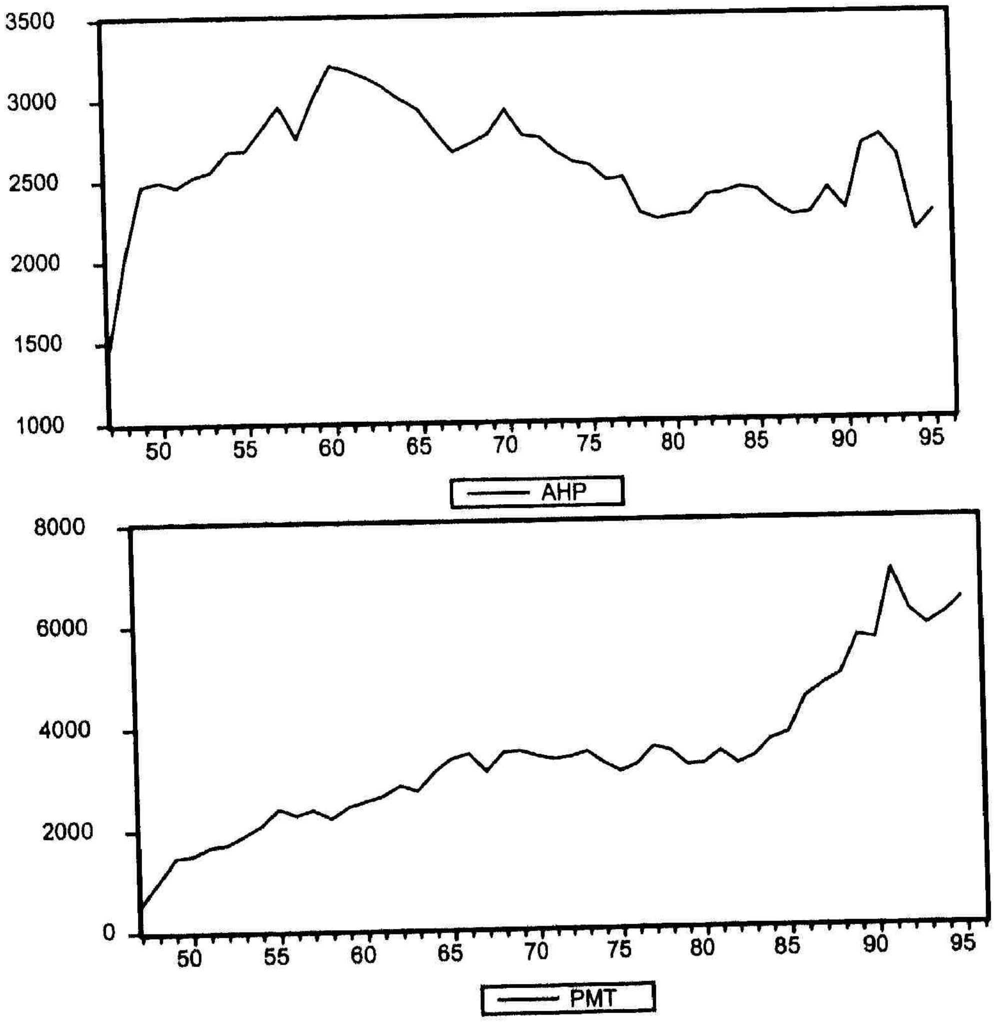
Figure 3.1: Plot Of Annual Ratio Made Tea To Green Leaves (CR)



Data source for the plot: Agriculture Statistics-Time Series (1988) and Cocoa, Coconut and Tea Statistics Handbook (1989-1996), Department of Statistics.

The plot in Figure 3.2 shows the plots of average hectareage in production and production of made tea from 1960 to 1996. It is clear from the plots that average hectareage in production shows a gradual decrease but the production of made tea have been increasing over the same period of years.

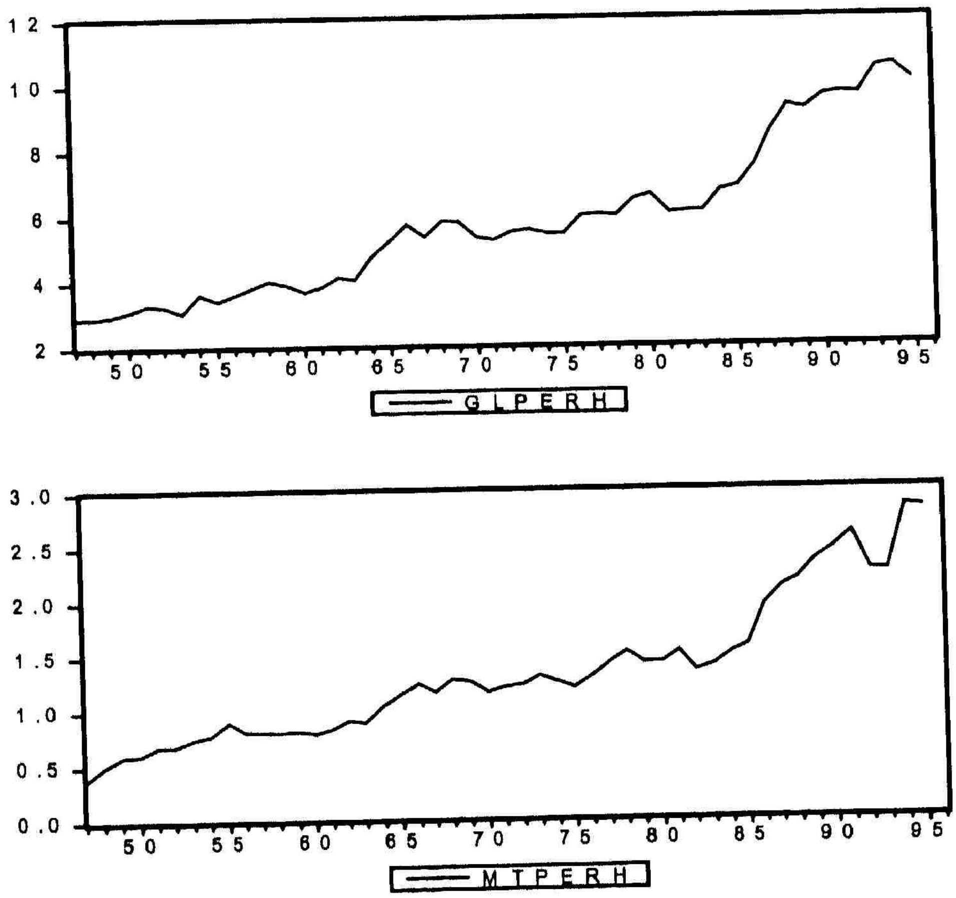
Figure 3.2: Plots Of Average Hecterage In Production (AHP) And Production Of Madetea (PMT)



Data source for the plot: Agriculture Statistics-Time Series (1988) and Cocoa, Coconut and Tea Statistics Handbook (1989-1996), Department of Statistics.

The plot in Figure 3.3 shows the annual plots of production of green leaves per hectare and made tea per hectare. In 1960 green leaves yield was 2900 kilograms per hectare and made tea was 384 kilograms per hectare. This has increased to 10072 kilograms per hectare for green leaves and 2823 kilograms per hectare for made tea in mid-nineties.

Figure 3.3: Plots Of Production Per Hectare (Yield) For Green Leaves(GLPERH) And Madetea Production Per Hectare (MTPERH)

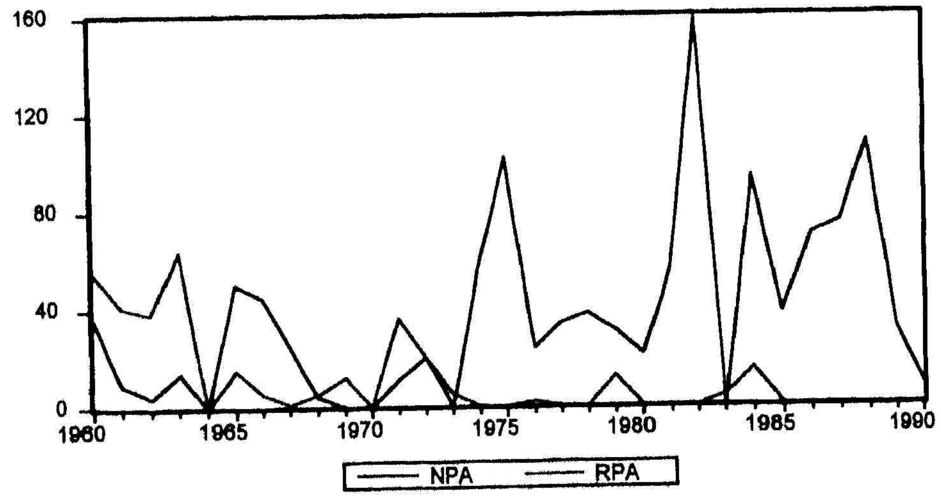


Data source for the plot: Agriculture Statistics-Time Series (1988) and Cocoa, Coconut and Tea Statistics Handbook (1989-1996), Department of Statistics.

The plot in Figure 3.4 shows the new areas cultivated with tea as well as replanted areas for the period 1960 to 1990. From 1960 to

The plot in Figure 3.4 shows the new areas cultivated with tea as well as replanted areas for the period 1960 to 1990. From 1960 to the mid-seventies there were new areas cultivated with tea and some replanting but hectareage involved was small. The period from mid-seventies to 1990 saw more land areas being opened up for tea cultivation, whereas hectareage replanted was small and only in certain years. The plot suggests that, during the period 1960 to 1990 opening of new areas and replanting were not carried in a large. For the period 1990 onwards, the Department of Statistics no longer provides information in the above form of breakdown and figures are given only for Malaysia not Peninsular Malaysia. Therefore, the plot only shows hectareage planted from 1960 to 1990.

Figure 3.4: Plot Of Annual New Planted Areas (NPA) And Replanted Areas (RPA) For The Period 1960 -1990



Data source for the plot: Agriculture Statistics-Time Series (1988) and Cocoa, Coconut and Tea Statistics Handbook (1989-1996), Department of Statistics.

3.3 Factors Affecting Yield

Yield is affected by many factors that in turn result in fluctuations (trend, seasonality; cycles) in the yield series. The degree of importance of these regular patterns varies from region to region, since tea is grown successfully in a wide range of geographical regions and of climatic conditions.

An understanding of the regular patterns and factors causing these patterns is crucial in the modelling process. Some forecasting techniques assume the presence of regular patterns in the time series so that appropriate forecasting techniques can be applied to give reliable forecasts. In some modelling techniques, the significant factors that cause fluctuations are even used as explanatory variables for the dependent variable. Therefore, knowledge and understanding of the factors causing the fluctuations that shape the yield series will make the forecast yields more meaningful to the decision-maker. Furthermore, the process of forecasting assumes that the regular patterns that shape the series will continue in the future. Thus, knowing the factors that are linked to these fluctuations can provide the decision maker with valuable information so that appropriate adjustments can be made to the forecasts or forecasting techniques in the event of a change in the explanatory factor.

Tea per hectare (yield) is affected by both uncontrollable and controllable factors. These factors cause variations or fluctuations in the yield. Leaf growth is of central importance because it is, in fact, the crop yield itself. The main uncontrollable factors that affect production or yield are climatic conditions, especially temperature, rainfall, air humidity and light intensity that is number of hours of sunshine. Among the controllable factors are tea varieties, manuring (application of fertilisers in terms methods, frequency and quality), pruning cycles, methods of plucking, control of pests and diseases as well as the method of processing. Economic factors like availability of labour, tea price and demand can also influence average production of tea.

3.3.1 Uncontrollable Factors Affecting Yield

In this section, the effects of climate on the growth or yield of tea is discussed and details of the climatic conditions in established tea areas are given. Temperature is expressed in degrees Celsius (°C) and rainfall is in millimetres (mm). Sunshine is given in terms of number of hours per day and humidity is indicated as relative humidity, that is the ratio between the actual water vapour content to the maximum amount that the air can retain at the same temperature.

Studies that have considered the relationship between climatic factors and production of tea include that of Eden (1965) and Williams (1975). Tea is grown successfully in a wide range of geographical situations and consequently in a wide range of climatic conditions, that is from humid tropical to sub-humid and temperate climates. Carr (1972) also reviewed the climatic requirements for tea in his study.

!.3.1.1 Temperature

Temperature is very important, as tea will stop growing when the emperature falls too low. Green (1970) in a study done in Malawi has shown that eaf expansion occurs only in temperatures above 21^0 C. In Malaysia, under ıumid tropical conditions, there is higher tea yield in the lowlands (mean max, emperature about 32°C) than in the highlands (mean max, temperature 25°c). This is attributed to temperature, Williams (1975). According to Harler (1966), if the difference between the daily average temperature in January and July is more than about 11 °C, the tea plant has a dormant period or one of very slow growth in the cool months, during which the haversting of leaf ceases to be economic. In general, mean minimum temperatures of below 13 °C are likely to bring damage to foliage and cessation of growth and mean maximum temperature above 30 °C is likely to be accompanied by humidities so low that a similar cessation of active development is inevitable. The optimum production temperature should never be below 13° C nor rise above 30 ° C.

In Peninsular Malaysia, the temperature conditions are best characterised to be "constant". This is because of the annual range of temperature for any part of the country remains below 2.5 °C and therefore there is a lack of seasonal variation in Peninsular Malaysia due to this, Nieuwolt (1982). There exist a few exceptions to the uniformity of temperature over different places. This is caused by elevation, which reduces temperature by about 0.6 °C for every 100 meters of height, Nieuwolt (1982). Seasonal uniformity is not affected by evelation and prevails at all levels, Nieuwolt (1982). A difference of more than 11 °C in daily average temperature in the annual range will result in a dormant period or one of very slow growth in the cool months, during which the harvesting of the leaf ceases to be economic, Harler (1966). Such differences in daily average temperature does not occur in Peninsular Malaysia over a period in a year and therefore it is save to say that temperature per se does not affect cropping in Peninsular Malaysia. Cropping season of tea in Peninsular Malaysia is twelve months. According to Green (1970) the difference in temperature based on elevation only effects the yield and quality.

3.3.1.2 Rainfall

Rainfall is an important factor influencing the rate of cropping of tea. Eden (1965) observed that distribution of rainfall is important for high yield. Minimum rainfall for tea is considered to be in the range of 1150-1400mm (40-55 inches) per annum and if monthly rainfall remains below 50mm (2 inches) for several months, crop production declines severely, Eden (1965). Tea plants need to have substantial quantity of water at its disposal. Water is removed from the soil by tea roots and lost from the leaves by evapotranspiration at a rate that varies from 140mm to 180mm per month. Ideally therefore, water should be available to the roots in amounts of this order each month. This amount of water lost by evapotranspiration will be increased by wind and hot weather and reduced by low temperatures and long periods of mist or cloud cover. In general there does not seem to be a decisive upper limit to the amount of rainfall under which tea will grow vigorously but, there is consensus of opinion that 1150-1400 mm per annum may be sufficient (Eden, 1965). Also the more even the rainfall distribution the less likely is the tea to be adversely affected by drought. If the monthly average rainfall falls below 50 mm over a period of several months, crop yield suffers severely (Eden, 1965). Dutt and Sharm (1967), Laycock (1958) and Portmouth (1957) also studied the relationship between yield and moisture. Laycock (1958) found annual yield in Malawi could be expressed by the equation Y=f(E,M,D) where Y=yield is 1000kh/ha, E=rainfall by early rain (Nov-Dec) in cm, M the main rains(Jan-May) and D rainfall in dry season(Jun-Oct) and found the regression coefficients were significant. Rainfall is an important factor influencing the rate of cropping of tea, but it's importance is secondary to temperature, as adequate rainfall at incorrect temperatures does not induce flushing.

The main characteristics of rainfall in Peninsular Malaysia are its variability. Rainfall is the most changeable element of climate, both in relation to time and place, (Nieuwolt,1982). Its diurnal, seasonal and annual distributions vary strongly from region to region and from year to year, Nieuwolt (1982). Rainfall is generally high in Peninsular Malaysia and total rainfall exceeds 1600 mm throughout in the country and is well over 2500 mm in many areas (Dale, 1959 and Nieuwolt, 1982). Tea requires a minimum of 50-mm rainfall per month or 1150-1400 mm per annum and all major tea plantations in Peninsular Malaysia meet this minimum requirement. Certain periods in a year experience heavy rain due to the monsoons, especially during inter-monsoon seasons. This occurs in the months of April and October. This heavy rainfall could affect the yield per se, thereby causing a slight seasonal effect. In fact, this is supported by a study in Malawi by Laycock (1958). The study by Ajjan and Rajagoplan (1989) used econometric models where the dependent variable was yield and one of the independent variables was rainfall. They developed models for two different places one where the minimum rainfall requirement is satisfied and the other where there were some dry months. They found that the coefficient of rainfall for the model with dry months is significant. In Peninsular Malaysia there are two periods of heavy rainfall where the first period gives high yield, that is quarter two which occurs during first inter-monsoon. But, the second period of heavy rain, which occurs during the second inter-monsoon, quarter 4, the yield is low. This shows that rainfall is a secondary factor and not the major factor causing fluctuations of yield. The yield does not follow the rainfall seasonality. The fluctuation in the yield is caused by a combination of factors including rainfall.

3.3.1.3 Sunshine (Cloudiness) and Humidity

Light is fundamental to crop growth because of its role in photosynthesis. Unfortunately, cloud cover and rainfall reduce the light energy available to plants. Therefore, the amount of sunlight received in the rainy months becomes an important factor in crop growth, Dale (1964).

The interrelationship between sunshine and moisture supply is fundamental to crop production. In the humid season or in generally high rainfall areas, the amount of sunlight becomes an important determinant of yield. On the other hand, in regions where a prolonged dry season occurs and where sunlight uring the wet season is low, the amount of dry season rainfall may become an nportant determinant of crop yield, Williams and Joseph (1981).

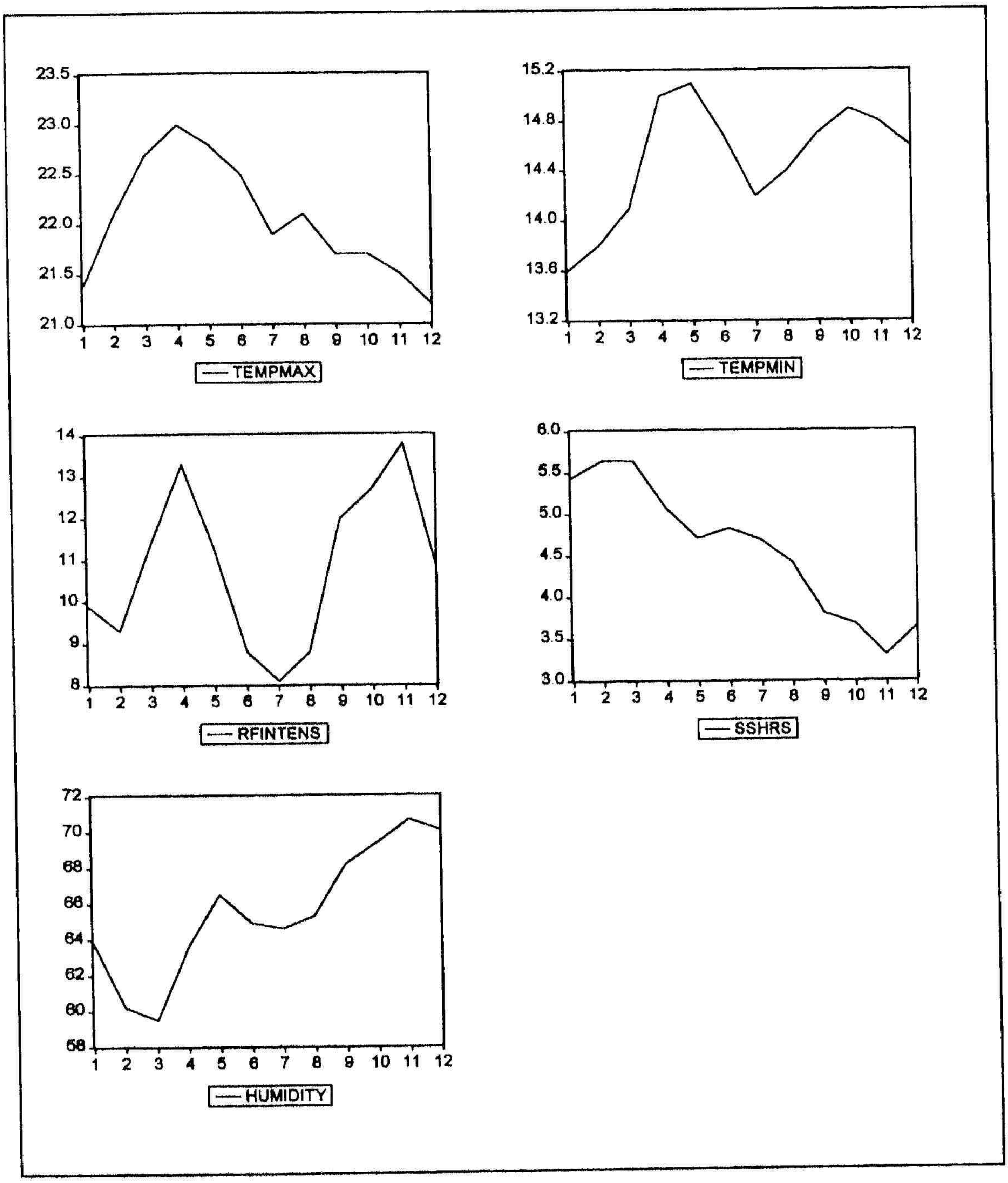
According to Nieuwolt (1982), in Malaysia the mean annual total hours of sunshine show strong regional differences and correlated with rainfall conditions. The highest annual totals are recorded in the regions where there are dry seasons and the mountains have relatively low total sunshine. The correlation with rainfall is also evidenced by the seasonal variations: low figures during October and November in contrast with high amounts during February and March. As for atmospheric humidity, it generally follows the rainfall conditions. Where a dry period prevails, the relative humidity may be as low as 40 or 50 percent during the afternoon, but during rainy spells the daily minimum remains usually over 70 percent. Highlands indicate high values of minimum relative humidity, because clouds often develop rather early in the day. This indicates that tea leaf growth rate and yield is affected by the combined factors of low sunshine hours and high humidity stress in spite of high rainfall.

3.3.1.4 The Relationship between Yield and Climatic Conditions

The growth of tea leaves and yield in Peninsular Malaysia is affected by more than one factor, which are interrelated to one another. In order to see this, monthly meteorological readings of mean daily temperature (maximum and minimum) over a period of 10 years, mean rainfall intensity (over 30 years), mean daily sunshine hours per day (period: 1968-1980) and mean daily relative humidity (over 10 years) of major tea area are shown in the plot in

-igure 3.6. The area selected here is Cameron Highlands which, accounts for 80)ercent of total production of tea in Peninsular Malaysia. The meteorological 'eadings of Cameron Highlands are extracted from tables of meteorological 'eadings in the Nieuwolt (1982) study. The plot shows clearly that the rainfall is ıigh during inter-monsoons (April-May and October-November) and sunshine hours are decreasing from January to December. As for humidity it is low just before the inter-monsoons and at other times it is high. Although the climatic conditions meets the minimum requirements which results in a cropping season of 12 months but combination of these climatic factors give rise to fluctuations and quarterly seasonality in the series. The yields for quarter 1 and quarter 4 are low. The climatic affect during quarter 4 is dull, damp, cool and wet due to high rainfall intensity because of the inter-monsoon season, followed by lowest sunshine hours (3.5 hours per day) and highest humidity readings which reduces the growth and yield up to January of the following year. First quarter sees longer sunshine hours and higher temperature, lower humidity and decreasing rainfall intensity, which leads to a climatic condition that, can be termed "dry spell". The continuity affect and "dry spell" together with other factors like pests leads to low yield in quarter one when compared to other quarters. Yield is highest in the second quarter. This is because, during this period it has high rainfall, long hours of sunshine (5 hours per day), highest temperatures for the year and not very high humidity which creates conditions for optimal photosynthesis. Third quarter shows lower yield but only a slight drop when compared to second quarter. This

Figure 3.6: Plots of Monthly Mean Meteorological Readings of Temperature, Rainfall Intensity, Sunshine Hours and Relative Humidity for Cameron Highlands.



TEMPMAX: Montly Daily Maximum Temperature (based on 10 years)
TEMPMIN: Monthly Daily Minimum Temperature (based on 10 years)
RFINTENS: Mean Rainfall Intensity (based on 30 years)
SSHRS – Mean Daily Hours of Sunshine Hours (based on 12 years)
HUMIDITY- Monthly Mean Daily Minimum Relative Humidity (based on 12 years)
Data Source for the plot: Nieuwolt (1982), pp. 17,28, 33 and 34.

because during this period, only rainfall intensity shows a sharp drop but other imatic conditions like sunshine hours (4.5 hours per day), temperature and ımidity are still ideal for photosynthesis. Drastic drop in rainfall intensity that is ıwest during the year is balanced by high humidity and decreasing ımperatures, which have less, impact in the growth rate and yield.

Therefore, the interrelationships between sunshine and moisture supply re fundamental to tea production. During humid seasons or in generally high ainfall areas the amount of sunlight becomes an important determinant of yield ınd combination of these climatic conditions gives rise to fluctuations and a ;easonal pattern in the yield series of this study.

3.3.2 Controllable Factors

There have been many improvements to controllable factors, which have brought an increasing yield performance over the period 1960 to 1996. This section will discuss some controllable factors that can be linked to the observed increase in yield.

3.3.2.1 Tea Varieties

Yields of tea per hectare depend on the tea varieties. According to Harler (1966), the Manpuri variety is hardy and a high yielder of good quality tea. But, the finest variety of all is the Assam Dark-leafed and it is a high yielder among the Assam varieties. In the work of Deanna (1981), an investigation was carried ıt on the tea varieties experimented and planted in Peninsular Malaysia. ccording to that study many varieties of Assam and hybrid were experimented terms of yield of made tea per hectare at Tanah Rata and Serdang Research tations. The study showed that Rajghur (cross between Assam and Manipuri ıt), Dangri and Charali are the higher yielding jats. In a tea survey carried out in 960, Highlands tea estates were planted with Rajghur and Betjan Assam and owlands estates were with Dangri (Dark leaf Manipuri) and Mixed ssam/Manpuri.

.3.2.2 Propagation and Nursery Care

According to Eden (1965) and Harler (1966), tea is propagated commercially by three methods, namely, seed, cutting and budding. The last two are comparatively recent developments brought about through increased pressure for high yields and product uniformity. Extensive clonal plantings are used in replanting and newly planted areas. High-yielding clones in India are reported to produce average yields of 25000 kg/ha in the 6th and 7th year of planting. In Ceylon the clone TRI 2032 has yielded an average of 2735kg/ha in the first year and 4800kg/ha in the second year of three pruning cycles, with heavy Nitrogen fertilisation (Fernando, 1969). This exceptional clone is also reported to have produced the phenomenal yield of 9000kg/ha (Harler, 1966; Nanayakkara, 1968).

In Peninsular Malaysia, according to some of the managers of major tea plantations, all replanting and newly planted areas are planted with clonal tea ants coming from TRI group. In fact, there is one major tea plantation, which pened new areas and these areas were planted with tea clone plants coming om TRI group. The planting of clone varieties started from early seventies and is practice is maintained till now. Although, the areas, which are newly planted replanted, is small but looking at literature on the yielding power of these onal plantings, there is great potential for increasing the yield.

.3.2.3 Pests, Diseases and Weeds

Diseases and pests also affect tea yield. Some of the pests and diseases ppear during certain periods when weather conditions are favourable. Helopeltis nsect moves and feeds only at or early in the morning. During most of the day it secretes itself in the depths of the bush on the underside of the leaves. It likes a moist warm atmosphere. The most common tea disease is Blister Blight caused by fungus exobasidium vexans massee. Moisture, high humidity and dull weather favour the development of this fungus. However the use of pesticides and chemical weeding have resulted in increased productivity per hectare, Eden (1965).

During the period of January and February 1981 a severe outbreak of Heliopeltis in the Boh Estate in Cameron Highlands caused approximately 10 percent crop loss (Deanna, 1981). As for tea diseases, the most common is Blister Blight caused by a fungus. Moisture, high humidity and dull weather conditions favour the development of this fungus especially in Cameron Highlands during the dull, rainy months of October to January. Young leaves are

›st susceptible to attack (Deanna, 1981). As this particular pest and diseases pear only during particular weather condition, that is, during first and third arter, therefore it indirectly causes fluctuations in yield along with these matic conditions. Hence, lower yields first quarter and third could not only be ıe to unfavourable weather conditions for leaf growth but also due to əliopelthis and Blister Blight. Over the years, improved methods of control, ›raying as well as use of new and effective chemical control pesticides and eedicides has brought about not only improved yield but also avoidance of ıajor crop loss from these pests, diseases and weeds.

.3.2.4 Application of Fertilisers

As early as 1903, Nanninga in Java and Hughes in Ceylon ınalysed leaves of tea and were able to show that the demands for nitrogen vere much greater thanthose for phosphate or potash, Williams (1975). The tea ›ush is cultivated for its leaves and strong vegetative growth is linked with high ıeed for nitrogen. A harvest of 1000 kg of tea removes from the soil around 40 to 50 kg N, 7 to 9 kg P_2O_5 and 20 to 25 kg K_2O. Time and method of application also plays an important role, as some fertilisers are highly soluble and utilised immediately. Hence, the application depends on the stages of plant development and seasonal characteristics of the region in which the tea is grown. Tea responds to high levels of Nitrogen. Akhmetov and Bairamov (1967) for example report yield response to 400kg/ha of Nitrogen. Eden (1965) and Harler (1966) have also indicated in their work that the time of application, method of plication, efficient and balanced proportion of use of artificial fertilisers have an ect on yield or leaf growth.

In Peninsular Malaysia application of fertilisers has been a practice ce early years of plantings. But, over the years the type fertilisers used has anged that is from organic to inorganic, the time of application especially rogen which is applied during drier months (March-April, July-August and vember-December) and another important change is in the method of plication. Major tea plantations like Boh Tea Plantations is changing from bour intensive application to aerial application of fertilisers. This method makes e application of fertilisers more evenly distributed than by hand application. ccording to the managers from Boh Tea Plantations, this method has great npact on the yield and has resulted in an increase in the yield. In Malaysia, ccording to Abd. Rahman and Ibrahim (1993), in the tea plantations of ameron Highlands which account for 70 to 80 percent of tea production in eninsular Malaysia, application of nitrogenous fertilisers is done during the nonths of March to April, July to August and November to December. During this eriod the rainfall is low or average. Hence, application is likely to be seasonal.

3.3.2.5 Plucking and Pruning

Harler (1965), stated that when a bush is pruned and plucked, a stimulus is given to leaf growth and the number of shoots in the second and later flushes tends to even up with those in the first. Pruning encourages the tea plant to produce leaf rather than wood. As the bush matures, moribund and unproductive nches develop and these must be removed. Pruning maintains the plant at leaf-producing stage. The pruning cycle ranges from 1.5 to 2 years in the ɪlands and 4 to 6 years in the highlands. In Malaysia, according to Abd. hman and Ibrahim (1993) pruning is done once in four years.

The method of plucking of tea in Peninsular Malaysia has undergone many anges. Initially hand plucking was done to give the best quality and minimal 'f grades". Plantations later started with the Tarpen trimmer but it was economical and quality of tea was poorer. Then, shears, which are imported ɔm Japan, were used but this had elongated plucking rounds, as regeneration as slower because all end buds are removed in the cutting operations. Now, ucking in almost all tea plantations are done using hand-held machines)eanna, 1982). Introduction of hand-held machines has led to the tea bushes əing constantly shaped and pruned to form a "table" for plucking. The pruning ycles in most plantations are 3-year cycles. The 'table' pruned shape, 3-year ycle of pruning and using of hand machine in plucking has increased the yield ver the years.

.4 Summary

From a review of the trends on some aspects of tea for Peninsular Malaysia, we observed that:

(i) there is a gradual decrease in hectareage planted,

(ii) more highland tea is produced than lowland tea, small scale replanting has taken place and not many new areas have been cultivated with tea,

the annual production of green leaves per hectare and made tea per hectare is increasing.

The increase in yield or upward trend can be linked to factors such as: ɘ of clonal varieties, effective methods of application of fertilisers, change in method of pruning, i.e. "table" form, effective control of pests and diseases d mechanised plucking. The seasonal effect in the yield series in Malaysia is e to the combination of factors like low temperature, heavy rainfall, high midity, and low sunshine hours. The controllable factors are very much linked uncontrollable factors. For example, the application of fertilisers and control of ɛst and diseases are dependent on the climatic conditions. Therefore, the ıcontrollable factors together with controllable factors further inflate or deflate e fluctuations. Increasing fluctuations may be due to increasing production of ghland tea, which is subject to climatic conditions.