

**ANALYSIS OF CLIMATIC PARAMETERS  
RAINFALL, TEMPERATURE & HUMIDITY ON TEA  
LEAF PRODUCTION: A CASE STUDY OF  
DHARMSALA TEA COMPANY**

**Meghna Sood**

*Research Scholar, Faculty of Commerce & Management, HP University, Summer Hill,  
Shimla HP (India)*

**ABSTRACT**

*The relationship between tea production and rainfall is well known. Tea grows well in area having a precipitation of about 1,150 to 8,000 mm. A study was conducted at Dharmsala Tea Company to see the effect of rainfall, temperature & humidity on production of tea. Results demonstrate that production of Tea is increasing since 2009 as compared to the past. Highest productivity of 164036 kg was obtained during 2015. Karl Pearson's Coefficient correlation of Tea production with recorded annual rainfall showed positive correlation ( $r=0.8315$ ) with tea production which means there is a tendency for high (production) X variable scores to go with high (rainfall) Y variable scores (and vice versa). Temperature is also important parameter for the production of tea. In the selected tea estate Temperature did not show any significant relationship with tea production. Also humidity did not show any significant relationship with tea production.*

**Keywords:** *Climatic Parameters, Humidity, Production, Rainfall, Tea Leaf, Temperature.*

**I. INTRODUCTION**

Tea is one of the oldest and most popular beverages in the world, the most widely consumed after water. It has truly become a beverage of international fellowship, a bond that brings people together. Tea is a product of the Camellia sinensis plant. For the highest quality tea, the tip or bud and the first two leaves are usually harvested for processing; the lower, more mature leaves can be used but are considered to be of lower quality. There are a number of different types of teas that come from the Camellia plant, which are differentiated by processing method and degree of oxidation. The most popular are black, green, and oolong teas.

Tea plantation industry is a combination of industry and agriculture (plantation is a large estate on which crops such as tea, coffee, rubber etc. are grown). Production of leaf is an agricultural activity while its processing is an industrial activity. Most of the large estates process raw leaf in their own factories. Tea industry is of considerable importance in the national economy of India in terms of income generation, earning foreign exchange, employment generation and contribution to the national exchequer (Merlin Joseph 2002).

In Himachal Pradesh tea is grown in the Mandi and the Kangra districts over 2063 hectare area (Indian Tea Association). Kangra renowned as "The valley of Gods" is famous for its distinct flavoured tea. Tea in

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Himachal Pradesh is grown at an elevation ranging from 700- 1500 meters above sea level, having a temperature range of 13 - 35 degree Celsius during March through October, the cropping season, and yearly precipitation around 2300 – 2500 mm of well distributed rains. Tea was first planted in Kangra by the British, and vast tea gardens (as the plantations are known) cover the gentle hills in and around Dharamsala and Palampur today. Some are privately-owned, some are so-called "demonstration plots," and some are research areas owned by the Himachal Pradesh Agricultural University or the Centre for Scientific and Industrial Research (CSIR). The socio-economic history of Indian tea is a wonderful saga of endeavour, courage and success. Tea has been cultivated and manufactured in the valley since the middle of the 19<sup>th</sup> century. In 1849 Dr. Jameson conducted a feasibility survey of the valley of Kangra in HP and found it suitable for tea cultivation. He brought China tea plants from the nurseries at Almora and Dehradun and planted them in Government gardens at Kangra, Nagrota and Bhawarna. Despite having suffered a good deal during transit the plants performed excellent in growth. This encouraged the government to go ahead for the establishment of tea industry in the valley. Kangra tea industry occupied prime position with respect to its quality from the last quarter of the 19<sup>th</sup> century to the third quarter of 20<sup>th</sup> century. Tea made in Kangra during this period was comparable with that of every part of the world. Both black and green teas are manufactured in the Kangra valley. Earlier black teas were manufactured by the Britishers only while the green tea by the native proprietors because the green tea manufacturing required very less machinery and also the market for green tea trade was available at Amritsar.

Kangra district is situated in the North-West Indian state of Himachal Pradesh. This is mountain country, very much part of the Himalayas with dramatic landscapes ranging from pine tree-covered slopes to frozen high-altitude deserts and deep gorges with bubbling streams that flow into the Ganges river of India, and the Indus river in Pakistan. The state shares a border with Punjab to the west, Kashmir to the north, and on the east side has Tibet as a neighbour. Uniquely, it's the only tea region in India that comprises exclusively China, or China-hybrid, tea bushes. Historical records say that Dr. Jameson, then Superintendent of the Botanical Gardens in Peshawar, now in Pakistan, visited the Kangra district in 1849, and pronounced that the lower slopes of the Dhauladhar range lying between 900 and 1400 meters were ideal for tea cultivation. The first commercial plantation was established at Holta near Palampur in 1852 at an elevation of 1260 meters above sea level. The seeds for planting were largely obtained from China and by 1892 the area under tea extended over 9,000 acres, with plantations owned by Europeans as well as native proprietors. The Gazetteer of Kangra district recorded in 1882-83 that "The tea now made is probably superior to that produced anywhere else in India (Aparna Datta, 2006). The demand has been steadily increasing and much is now bought by natives for export via Peshawar to Kabul and Central Asia." Kangra tea reached European markets through London, Barcelona and Amsterdam and even won gold and silver medals at exhibitions in European capitals during 1886-95.

Today tea in Kangra is dominated by few major tea gardens viz. Palampur Co-operative Tea Factory, Manjhee Valley Tea Estate, The Wah Tea Estate, Dharamsala Tea Company. The rest are small growers. Dharamsala Tea Company was started in the year 1882. Climatic factors, which include rainfall, temperature, and humidity determine the success of tea production of a region. Of these, perhaps rainfall and temperature play the most important role in the development and growth of plants and ultimately yield per unit area. Since the Dharamsala Tea Company is 135 years old the study was conducted to assess the present pattern of tea production and how

microclimate (rainfall, temperature and humidity) impact on the productivity of tea leaf at Dharmsala Tea Company.

## II. DHARMSALA TEA COMPANY

Dharmsala Tea Company was established in the year 1882. It was bought by great grandfather of Gurmeet Singh Mann the present sixth generation owner from the Britishers. Till the year 2004 green tea was produced in the factory. From 2005 onwards they have shifted to black orthodox and other speciality tea like white tea, green tea and oolong tea. Teas are packed in the tins and cartons in the name of Mann Brand. They also directly export tea to European countries like Germany and France. The Dharmsala Tea Company owns 65 hectares of land which stretches from Sheela Chowk to the hill tops of Indru Nag.

The tea estate is divided into three parts Hoodle Tea Estate, Mann Tea Estate and Towa Tea Estate. Hoodle Tea Estate spreads into 25 hectares of land; Towa Tea Estate also spreads over 25 hectares of land and Mann Tea Estate covers 15 hectares of land and is near to the Tea factory. The last year production of the Dharmsala Tea Company was 164036 kg.

## III. RESEARCH SITE

The research site is Dharmsala Tea Company. The Dharmsala Tea Company is situated at Dharmsala. Dharmsala lies on a spur of the Dhaola Dhar, 16 miles north-east of Kangra, in the midst of wild and picturesque scenery. Dharmsala (also Dharamshala) is a city and a municipal corporation in Kangra district in the Indian state of Himachal Pradesh. It is the district headquarters. Dharmsala is a city in the upper reaches of the Kangra Valley and is surrounded by dense coniferous forest consisting mainly of stately Deodar cedar trees. Beside scenic tea plantations, Dharamshala is most significant area for natural waterfall, green hillock etc. This beautiful scenery always attracts national and international tourists to visit Dharamshala.

## IV. METHODS OF DATA COLLECTION AND ANALYSIS

Kangra region of Himachal Pradesh is the major tea leaves producing zones along with other agricultural crops due to its climatic condition and geographic position. Therefore, this area was selected purposively to conduct this study. An exploratory survey on Dharmsala Tea was done to collect information on the production and changing impact of rainfall, temperature and humidity on tea leaf yield. The study is based on both primary and secondary data. The climatic data was collected from Dharmsala Tea Company. A separate schedule was prepared for the workers and the factory owners. The secondary data have been collected from various journals, articles, books, published government reports, magazine/newspaper reports, documents put in public domain on Himachal Pradesh website and documents put on websites of various universities, renowned organisations and governments world over (including the website of Central Government and State Government of India, Tea Board of India). Research papers are retrieved from various libraries, Computer Centre where the journals are available online and also requested reprints of research papers from the authors through emails. Also the internet was surfed prolifically for the materials on Tea industry. The secondary sources consisted of PhD Dissertations, research papers related to the conditions of tea plantations, problems faced by the workers and the issues related

to the downfall of the tea industry beside these relevant files, records, maps, photographs and documents related to the research topic were studied. Primary data are collected for understanding the effect of climatic conditions on Tea Plantation Industry. The sources of primary data are interviews/discussions with the workers and the plant owners, various internal circulars/file pages and documents handed over by the manager of the Dharmsala Tea Company during the interviews and personal communication with the workers and direct observation in the field.

The Statistical Package for Social Sciences (SPSS) is used to analyze the data statistically. The questionnaires are analyzed one by one and then interpreted in the light of the statistical results.

## V. RESULTS AND DISCUSSION

In favour of the maintenance of good quality tea it is required to collect one bud and two leaves but in the field observation it is noticed that more than two leaves and a bud were collected. Thus the quantity may increase but the quality of the tea hamper. The total quantities manufactured in Kgs. From 2008 to 2015 recorded at Dharmsala Tea Company is shown in below Fig. 1

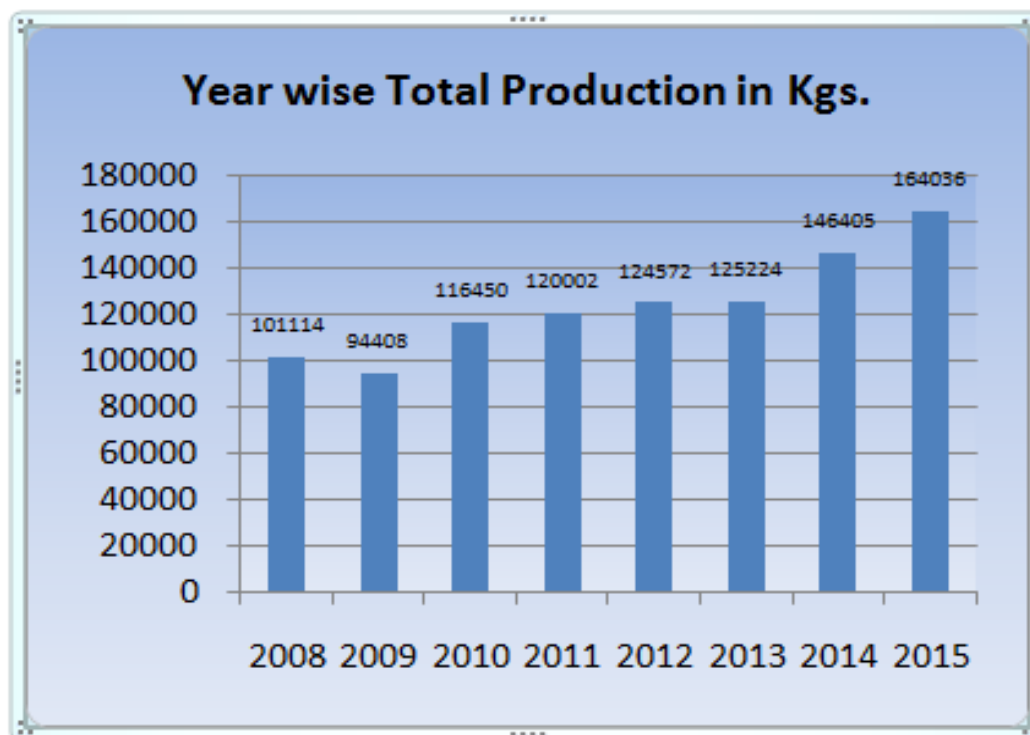


Figure 1 Year wise total production in Kgs.

### 5.1 Effect of Rainfall on Tea Leaf Production

Rainfall was positively related with tea production in Dharmsala Tea Company. In the previous 8 years, the minimum rainfall was recorded 2505.28 mm where as maximum rainfall was recorded 3869.56 mm. The tea

leaf production and rainfall in Dharmsala Tea Company was strong correlated and had positive influence on each other.

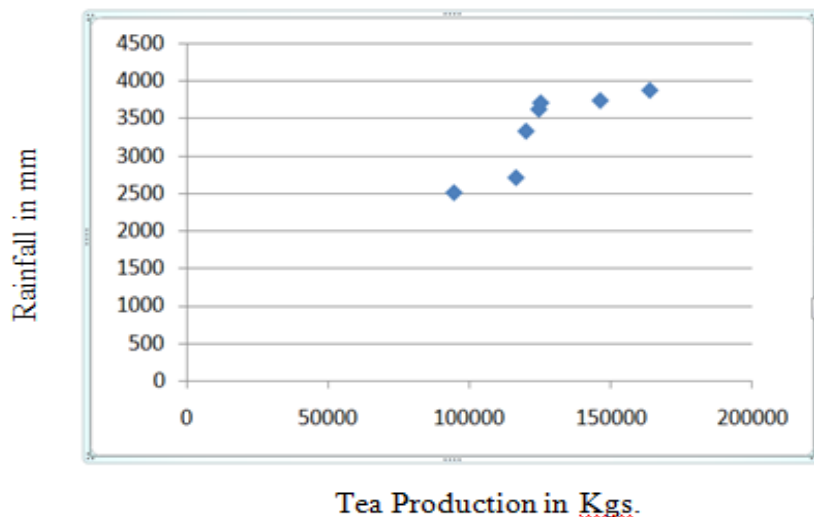


Figure 2 Tea Productions with Annual Rainfall

### 5.2 Effect of Temperature on Tea Leaf Production

Temperature is also important parameter for the production of tea leaf. Temperature did not show any significant relationship with tea leaf production. The existing temperature is suitable for tea production in the estate. Tea leaf production did not respond in relation to temperature. It is because the amount of rainfall in the estate was high. The Karl Pearson's coefficient correlations of tea production with recorded annual average minimum & maximum temperature are negatively correlated.

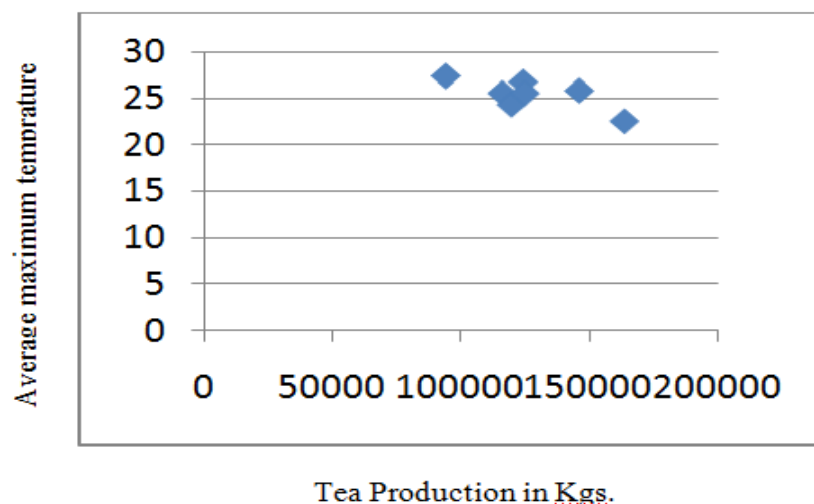


Figure 3 Tea Productions with Annual Maximum Rainfall

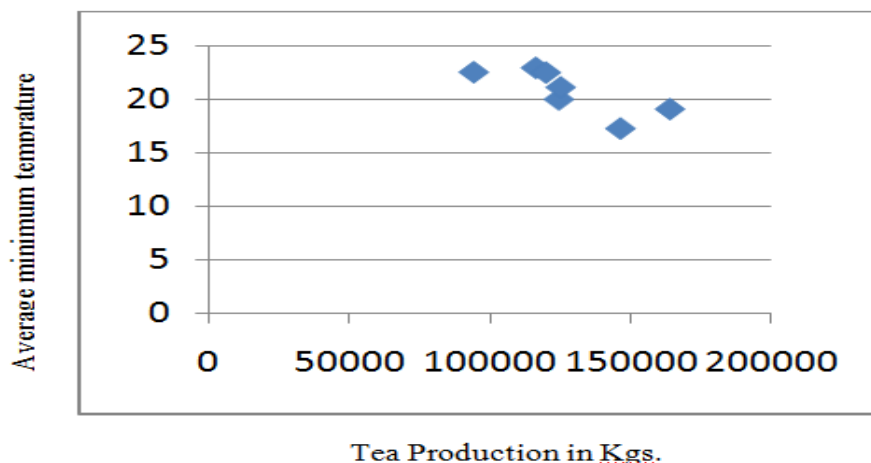


Figure 4 Tea Productions with Annual Minimum Rainfall

### 5.3 Effect of Humidity on Tea Leaf Production

In the Dharmsala Tea Company the selected tea estate humidity did not show any significant relationship with tea production. Humidity is increased with increase in temperature and precipitation. In the selected tea estate there was suitable rainfall and temperature. Thus the humidity was also perfect for tea leaf production. Hence it had not direct effect on tea leaf production. In Dharmsala Tea Company it was observed that the tea production is independent about mean annual humidity.

The Karl Pearson's coefficient correlations of tea production with recorded annual average minimum & maximum humidity are negatively correlated.

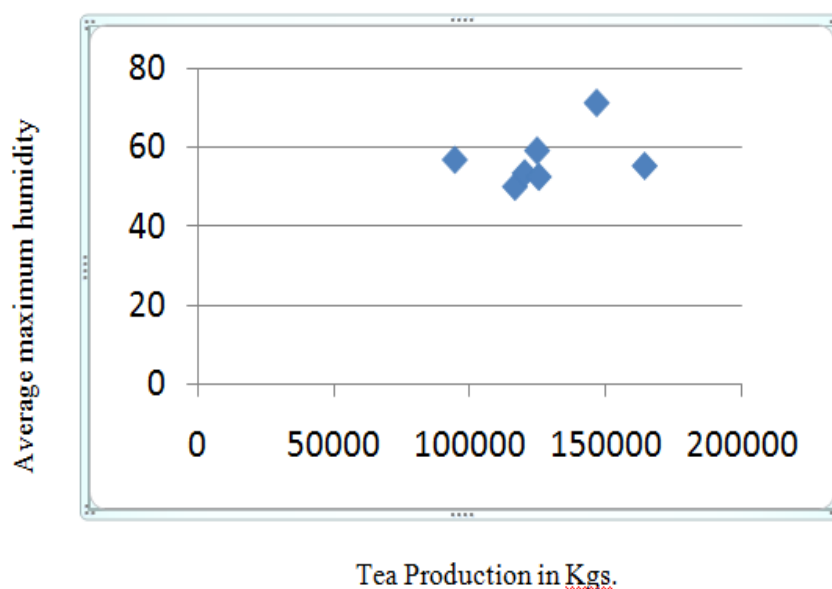
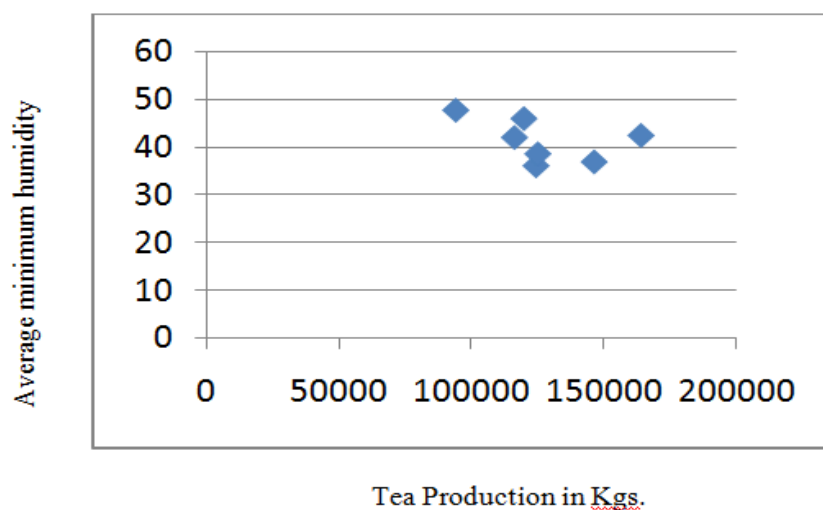


Figure 5 Tea Productions with Annual Maximum Humidity



**Figure 6 Tea Productions with Annual Minimum Humidity**

## VI. CONCLUSION

Heavy or scanty or delayed rainfall adversely affects the growth and yield of tea but it has been found that tea leaf production is increasing in the Dharmasala Tea Company due to increased rainfall. Temperature and humidity had no direct effect on tea leaf production in Dharmasala Tea Company. The study found that, mean annual rainfall and production is positively correlated. The present study suggests that if climatic changes due to low rainfall and significant increase in temperature will be resulted in a significant loss of yield of tea leaf production.

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