CHAPTER-II

HISTORY OF TEA PLANTATION AND TEA INDUSTRY

INTRODUCTION

The story of tea began in ancient China over 5000, years ago. According to legend, Shen Nong an early emperor was a skilled ruler, creative scientist and patron of arts. His orders were all drinking water should be boiled as a hygienic precaution (world of tea.com). One summer day while visiting a distant region of his realm, he and the court stopped to rest. His servants began to boil water for the court to drink. Dried leaves from the near by bush fell into the boiling water, and a brown liquid was infused into the water. As a scientist, the Emperor was interested in the new liquid, drank some and found it very refreshing. And so according to legend, tea was created.

For centuries tea has occupied an important position in our social and cultural life: discussions are held, social contracts are developed, matrimonial alliances confirmed, guests are received, a long last friendship renewed and many a commercial deal clinched over a cup of tea. Tea is offered with a feeling of warmth, gratitude and mutual respect. It is interesting that no other drink is associated with such positive values of human existence.

A cup of tea is such an integral part of our lives, and "any time is tea time" is a phrase so common in any language or vocabulary that it hardly calls for any reflection. It is consumed by all – irrespective of caste, creed, class, status, income and age. It fosters friendship and fellowship (Jhawar R.S, 2002).

This universal drink is today emerging as a new age "super drink" that is not only beneficial for physical health but also for the spiritual health of the society as it directly or indirectly promotes human values. As perception of tea changes, its image is evolving from a "genteel drink" of the past to that of a mainstream beverage of choice for today's active, healthier lifestyle. It has also been termed as an "executive drink" for an overworked executive who has to meet his deadlines at short notice.

The lush tea gardens with vast expanse of green plantations provide an eco-friendly environment that improves the climatic conditions of the region and contributes to the beauty of the landscape. Gone are the days of tea gardens with their luxurious life styles in the bungalows of the British days. Today, these are temples of dedication and devotion, where the entire plantation community works, often under difficult circumstances, for our daily cup of tea.

2.1 ESTABLISHMENT AND GROWTH OF TEA PLANTATION

2.1.1 Place of Origin

The place of origin of tea is still a matter of speculation (Barua D.N, 1989). Our knowledge of tea is derived from China but information available from the Chinese sources does not throw much light on its place of origin. Discovery of a wild prototype of the plant cultivated in China would have assisted the search for its original home but no wild tea plant appears to have been discovered in China, nor can such a discovery be expected now, after the plant has been in cultivation for nearly 2000 years over a wide part of the country.

The situation is different for the Assam and the Cambodia races of tea. Since the early part of the nineteenth century, discovery of the wild plant of these two races has been reported from Assam, Manipur, Mizoram, Burma, Thailand and the entire Annamite chain from the extreme north of the gulf of Tonkin to South Vietnam and Laos. It is, however, not certain whether the plants were wild or relics of plantations abandoned by the migratory tribes of these regions.

The tea tracts discovered by Bruce in Assam were almost certainly clumps of cultivated tea abandoned by the migratory hill tribes. Watt and Mann (1903) seemed to hold the same view. The inhabitants of northern Burma on the other side of the mountain range that divides Assam from Burma, were known to use tea as a vegetable (letpet tea), for chewing as well as for making a drink out of it (Watt ,1896). In the Indo-China peninsula, tea was an important village industry for many centuries long before the discovery of the Assam plant (Du Pasquier, 1924). Hence it is doubtful whether the plants discovered in these regions were truly wild.

The problems of origin and disposal of the tea plant was examined in depth by Wight who made his views known to Kingdon Ward. According to Wight, tea might have originated in the region around the point of intersection of latitude 29°N and longitude 98°E, near the source of the river Irrawaddy, which is the meeting ground of Assam, North Burma, South-west China and Tibet.

A number of expeditions were undertaken by kingdon Ward before and after the Second World War into upper Indo-China, North Burma, Southern Tibet and the mountainous regions of North-East India in search of wild tea as well as to test the hypothesis of Wight. Kingdon-Ward postulated that the primary centre of origin of tea must have been located as far north as the 60th parallel or even within the Arctic Circle (Barua D.N 1989).

All the three races of tea hybridize freely. Through the activities of men, the geological barriers had broken down in the course of time making it almost impossible now to find any of the races in pure state even in the terminal areas of their dispersion.

2.1.2 Classification of Tea Plants

The genus Camellia of which tea is a member belongs to the family Theaceae, tribe Gordonieae, along with eight other genera, among which camellia is the largest. There are three basic varieties of tea plants.

(i) The China Type

Camellia Sinensis L or The China Tea Plant is a big shrub, 1-3m tall with virgate stems arising from the base of the plant near the ground giving rise to a dome shaped bush when full grown. Leaf is hard, thick, leathery, dark matt green. Flowers are born singly or in pairs in the cataphyllary axils.

(ii) The Assam Type

Camellia Assamica (Masters) or The Assam Tea Plant is a small tree, 1.0 - 1.5m tall with a trunk sometimes up to one third of it's height and looks like a small tree. The tree has a thick distinct trunk. Leaf is large, light green thin, glossy with more or less acuminate apex and distinct marginal veins, leaf blade are usually broadly elliptic. Branches are thick and ramifying. Flowers are single or in pairs on the cataphyllary axils.

(iii) The Cambodian Type

Camellia Assamica Sub-Group Lasiocalyx Planch M.S or the Cambodian or Southern form of tea is a small fastigiated tree, 6 - 10m tall, with several upright, equally developed branches. Leaf is glossy, yellowish-green when young and light green at maturity (TRA 1992).

2.1.3 Types of Cultivated Tea

The three types of cultivated tea are:-

Camellia Sinensis (China Hybrids)

Camellia Assamica (Assam Hybrids)

Cambodiensis (Cambot Hybrids)

The tea tracts discovered by Bruce in Assam were almost certainly clumps of cultivated tea abandoned by the migratory hill tribes. Watt and Mann, (1903) seemed to hold the same view.

Table 2.1 Distinguishing Anatomical and Chemical Characters of the Three Races of Tea (After Barua, 1963)

China	Assam	Southern Form
Sclereids absent or rare. Sclereids slender, almost without spicules.	Sclereids numerous. Sclereids stout with a few spicules.	Sclereids
Lumen of sclereids almost completely closed.	Lumen of sclereids of irregular width closed in places. Triglycosides absent.	
Triglycosides present in fairly large amount. IC absent.	IC absent.	

2.1.4 The Planter's Classification of Tea Plants

The Assam Planters of today recognizes four main groups, or jats, of tea plants:-

1. The China
2. The Cambodian
3. The Assam and
4. The Hybrid.

The last may be a cross between any of the first three.

(i) The China Jat - The China Jat is a bush up to 3m high with many stems. The leaves are small, hard and matt, slightly serrated and standing erect on the branch. The plant is hardy but does not yield well, and the leaf gives poor liquors. Under these conditions, however, the China jat gives teas with highly-valued flavours.

(ii) The Cambodian Jat - The Cambodian Jat is a small tree, about 5m high with small shiny and hard erect leaves, folded v-shaped, with slight serrations and definite apex. In autumn the leaves are often red in colour and some flavour may be produced.

(iii) The Assam Jat - In Assam group he recognizes five sub-groups-the Lushai, the Burma, the Manipur, the light-leaved and the dark-leaved Assam. All these groups and sub-groups are also called jats. The Assam jats are trees with big glossy bull ate leaves, usually markedly serrated and with a definite apex (www.the-teapot.com).

(iv) The Lushai Jat- It is a tree 18m tall, with big pendant flabby leaves up to 35 cm long. It is not grown in plantations for it is a poor cropper and the tea from it may have an undesirable flavour, as of Balsam. The light-leaves Assam jat is also unpopular, because of its delicacy, under favourable conditions in the Assam Valley.

(iv) The Burma Jat – It usually has leaves which are broader than those of the other jats within the Assam variety. The leaves are often deeply serrated, while the older leaves have a bluish tinge.

(v) The Manipur Jat- It has longer leaves than the Burma jat. Both the Burma and Manipur jats are hardy, and produce good liquoring teas. They are grown in Cachar, Sylhet, Dooars and the Terai, where drought conditions are often too severe for the Assam jat.

The Assam Jat as defined by the planter has leaves which are sometimes without a marked apex, and are less pendant than those of the other Jats. The leaf is glossy, bull ate and deeply serrate. Some of the Assam Jat of plants are highly pubescent (hairy) young leaves and buds, and these give quality liquors throughout the season and very marked qualities during the second flush in Assam. This kind of bush is delicate but it thrives in Assam.

2.1.5 Introduction of Tea Cultivation in India

In India indigenous tea plant was grown in Assam, but the honour of discovery of the Assam tea plant is usually attributed to Robert Bruce who is supposed to have seen plants growing wild in some hills near Rangpur (near present Sibsagar), then the capital of Assam, which he visited in 1823 on a trading mission (Ukers,1935). At that time, he made arrangements with a Singpho Chief to supply him with some tea plants during his next visit in the following year. Assam was then under Burmese occupation and war broke out with the Burmese in 1824. Robert Bruce also died in the same year before he had a chance of collecting the tea plants.

When Robert Bruce, died in 1824 his brother C.A Bruce a naval officer was transferred to north-east India in charge of a division of gunboats (Jhawar R.S 2000). After completion of his mission, C.A Bruce interviewed the Singho Chief who supplied him some tea plants and seeds. Most seeds were planted in Bruce's garden at Sadiya and some were sent to Commissioner Jenkins at Guwahati. A few leaves of this plant were sent to the Botanical Gardens in Calcutta. Dr. Wallich, who was then the superintendent of the Botanical Gardens, identified the leaves as belonging to the Camellia family but did not consider them to be of the same species, as tea, meaning the China tea plant. In 1978, the East India Company seeking an alternative source of supply, requested the naturalist Sir Joseph Banks to study the possibilities of planting tea in India. Sir Joseph recommended cultivation in Bihar and Koch Bihar. But the East India Company was more concerned with the Company's highly profitable monopoly of the China tea trade (I.T.P.A 1965). Nothing came of Sir Joseph's suggestion though tea plants from China seeds were successfully raised in the Botanical Gardens.

The indigenous tea plant which was the ancestor of Chinese Tea was all the time flourishing in the wide hills of Assam, just beyond the then frontier of British India. In 1823, this was traced by an Indian, Late Moniram Dewan, though East India Company completely suppressed the claim of the Indian finder and gave credit for the discovery to Major Robert Bruce who had gone to Assam on an expedition. In 1833 Lord William Bentinck, the Governor General of India, appointed a tea Committee to advise on the possibility of commercial cultivation of tea in India- the recommended regions were:-

(a) The lower hills and the valley of the Himalaya

(b) The Eastern frontier and

(c) The Nilgiris and the western part of South India.

The Committee issued a circular asking for information on areas suitable for tea cultivation and dispatched its secretary, G.J Gordon, to procure tea seeds, plants and workmen from China. In response to circular, the Commissioner of Assam, F. Jenkins made a strong case in favour of tea cultivation in Assam where tea plants were found growing wild in forests. He also collected complete specimen of local plant and forwarded them to the Governmental Botanical Gardens in Calcutta. A scientific Commission was constituted in 1835 with Dr. Wallich, Dr W. Griffith and Dr J. McLelland to report on the Indian indigenous tea and to advise on the most favorable localities for starting experimental tea gardens. The scientific Commission visited Assam in early 1836. C. A Bruce, acting as a guide took the member to a number of tracts at the foot of the Naga and Patkai hills as well as to a few river valleys where the indigenous tea plants were growing in clumps. Having seen the tea bushes, Wallich expressed the view that there is no need to import tea seeds from China, while Griffith favored importation of the China seed because "a wild plant is not likely to give as good a produce than one which has been cultivated for centuries." It was finally decided that the "China plant and not the degraded Assam plant" should be used for the government experiments. The Committee failed to come to a general agreement regarding the most favourable localities for establishing experimental gardens. Wallich favoured the Himalayan region while the other two favored upper Assam where wild tea existed. So Gordon was again sent to China in 1836 and for many years China tea seed was imported regularly into India (Tea Directory).

From seeds brought by Gordon, nurseries were raised in the governmental garden in Calcutta and the plants were sent to Upper Assam, Dehradun, Kumaon and Nilgiri hills. The site selected for the experiment in Assam at Saikhowa near Sadiya was not a happy one where many plants died. The surviving plants were moved to a new site near Chabua about 25 km between east of the present town of Dibrugarh. Seedlings sent to the Himalayan region were

planted at two sites near Bhimtal and Almora. Later on experimental gardens were successfully established with China plants in Kumaon, Garhwal and Kangra districts of the Himalayan foothills. In 1834, the Tea Committee dispatched 2000 plants from Calcutta to be planted in South India as a subsidiary of coffee plantation. It turned to be a failure after "leaf rust" disease damaged the plants (Jhawar.R.S, 2000).

Tea Producing Areas in India

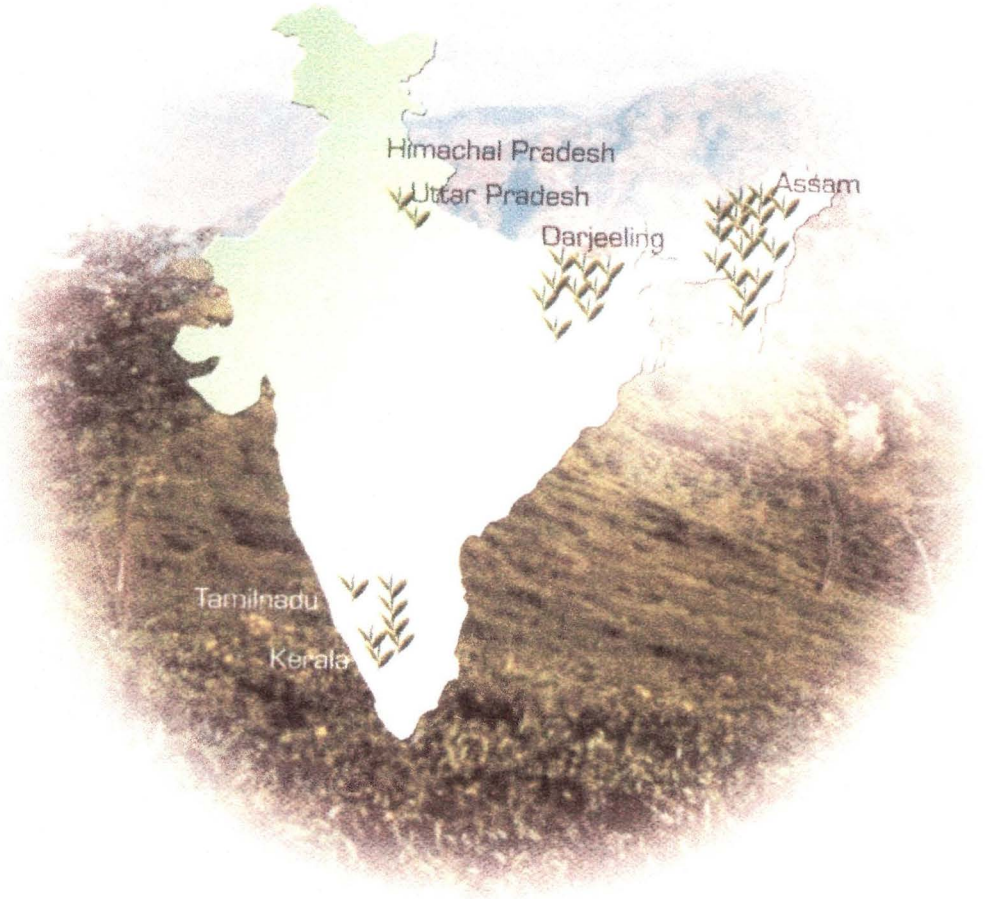

Fig 2.1

Along with establishing experimental plots with the China plants, seeds received from Calcutta, C.A Bruce who was then appointed as Superintendent of the governmental tea

plantation raised nurseries of the tea plant. The first experimental samples of tea from the indigenous plants were sent to Calcutta in 1836. By 1837, tea was successfully cultivated in Upper Assam and in May 1838, a few chests were shipped to London headquarters of the East India Company. The first consignment of eight chests of tea was auctioned in London in 1839, heralding the advent of Indian tea in the world market.

2.1.6 Major Tea Growing Areas in India

The major tea growing areas in India are located in the Assam valley, Cachar, Darjiling, Dooars, Terai, Tamil Nadu, Kerala and Karnataka. The major part of the production comes from eastern and north-eastern parts of India (Bidyut Sarkar, CCPA 1984). Several other states, including Tripura, Arunachal Pradesh, Sikkim and Meghalaya have started growing tea. Experimental plantations are also on the cards in several other states under government patronage. (Fig 2.1)

2.1.7 World's Major Tea Growing Countries

A. India

With nearly 25,000 tea estates, India is the largest producer and consumer of tea. Almost all of the tea produced is 'Black tea', although small quantity of green tea is also produced. The finest tea comes from the hills of Darjiling where there are approximately 42,000 acres of tea cultivation, and the valleys of Assam. The Darjiling tea is famous for its flavour. Assam tea is grayish to black in colour. This tea has strong bright liquor.

The foothills of Darjiling in West Bengal also occupy a significant position in the tea map of India. After the industry was established as a commercial enterprise in Darjiling, planting was extended first to Terai and then to the Duars, which together constitute the narrow strip of land, approximately 300km in length, at the foot of the Darjiling and Sikkim Himalayas, from the eastern border of Bihar to the river Sankos on the Assam border.

B. China

Tea consumption spread throughout the Chinese culture reaching into every aspect of the society in 800 A.D. Lu Yu wrote the first book on tea, the Cha Ching. This amazing man was orphaned as a child and was brought up by Buddhist monks in one of China's finest monasteries. His fame as a performer increased with each year, but he felt his life lacked meaning. Finally, in mid-life he retired for five years into seclusion. He codified the various methods of tea cultivation and preparation in ancient time. He lived the life of sainthood. His work clearly showed the Zen Buddhist philosophy to which he was exposed as a child. It was

this form of tea service that Zen Buddhist missionaries would later introduce to imperial Japan (world of tea.com).

In the present scenario, China stands next to India so far as production is concerned. A variety of tea comes from China, the place where tea was born. Two-third of China's annual production is green, which is most popular at home. The most popular variety of Chinese tea is called the 'keemun' a Black Tea from Anhui province. Keemun is also used with a flavour as a base for iced tea in USA (Jhawar R.S, 2000).

C. Japan

The first tea seeds were brought to Japan by the returning Buddhist priest Yeisei, who had seen the value of tea in China in enhancing religious meditation. As a result he is known as the "Father of Tea" in Japan. Because of this early association, tea in Japan has always been associated with Zen Buddhism. Tea received almost instant imperial sponsorship and spread rapidly from the royal court and monasteries to the other sections of Japanese society. Tea was elevated to an art form resulting in the creation of the Japanese Tea Ceremony ("Cha-no-yu" or "the hot water for tea") (world of tea.com).

The Japanese believe that "tea is more than an idealization of the form of drinking; it is the religion of the art of life". Tea leaves are also used in Japanese textile designs. Although the Japanese drink mostly "Green tea" but recently a trend is seen among the Japanese tea drinkers to turn to "Black Tea" (Jhawar R.S, 2000).

D. Sri Lanka

Sri Lanka, world's third largest tea producer, and the largest exporter, supplies nearly 25% of the world's tea, and has an area of 600,000 acres under tea cultivation. Sri Lankan tea is processed black. It has brightness and flavour. Forty percent of Sri Lanka's tea estates are located at an altitude of over 4000 ft.

2.1.8 Spread of Tea in the Rest of the World

India's success story spread to Java (1684), Sri Lanka (1837), Taiwan and Formosa (1868). Encouraged by the world wide wave, Russia entered the fray towards the end of the 19th century and began plantations in the Caucasus region in 1905. Introduced in 1850, Africa is today one of the fastest growing tea regions in the world (Malawi: 1877, Mozambique: 1920, Zimbabwe: 1925, Uganda: 1900). Kenya was a late starter (1925). Today, tea is grown in at least 45 countries –and over half the population of the earth drinks over 3.5 billion cups a day.

World Distribution of Tea Production

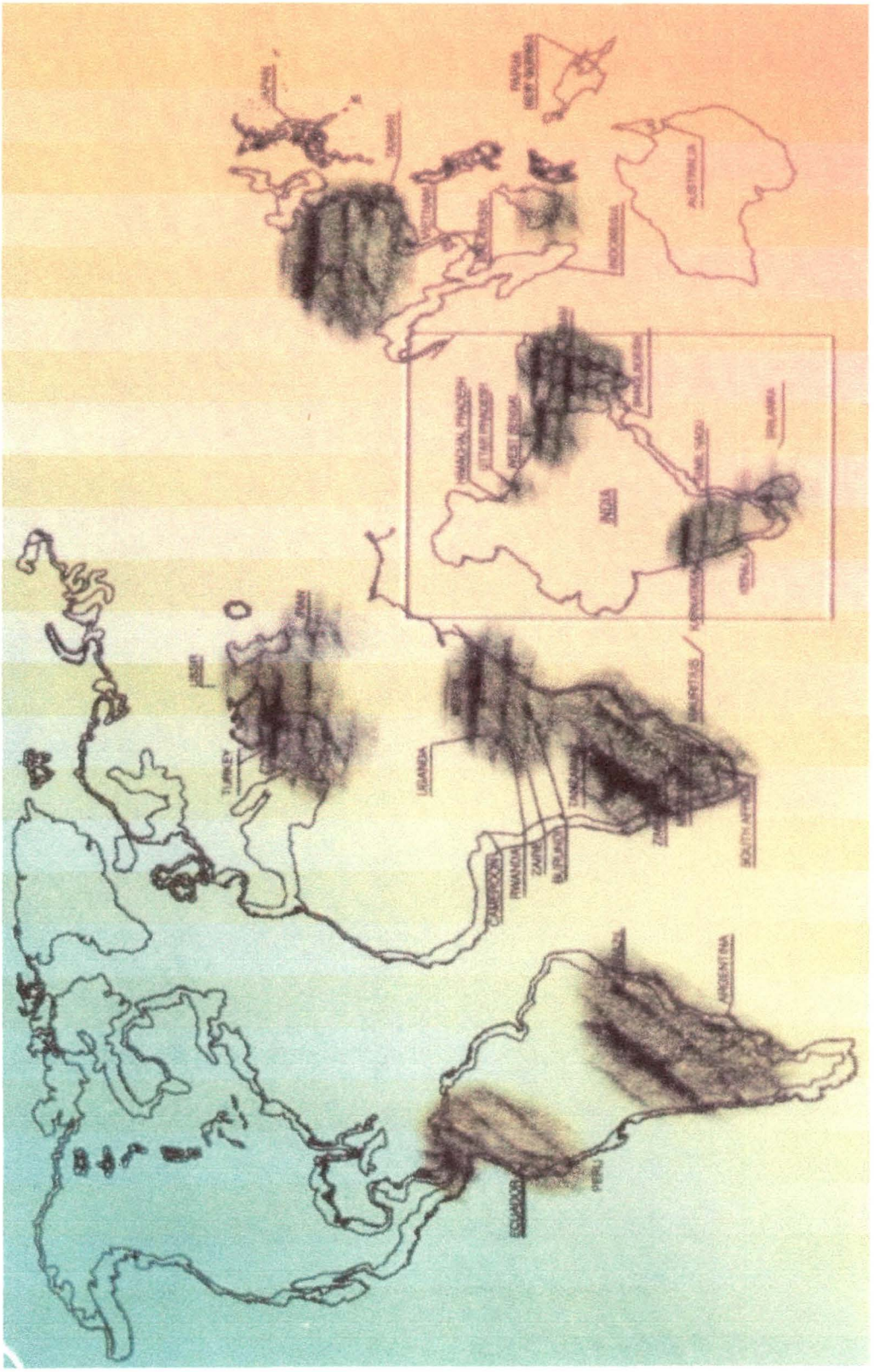

Fig 2.2

A. Tea in London

News of this "wonderful oriental beverage" was carried to Europe in the 16th century by the Portuguese and the Dutch seamen returning from the far-east. Tea from China was imported into Holland in the 16th century, which was the beginning of the tea drinking habitat in Europe. The first box of tea is said to have arrived in Britain via Holland. Gradually tea became popular in Germany, France and other countries.

It is often said that tea brought about the beginning of a social revolution to the west, giving women the "privilege" of accompanying men to the tea houses. The beverage was of considerable importance as it was regarded as means to bring down consumption of alcohol by men. In the English homes too, afternoon tea became a tradition. According to "The Dictionary of British Social History" by L.W Cowie, the first commercial tea shop was opened in London by Thomas Twinning, where tea was "served to both men and women"-breaking a tradition that unlike coffee houses, women were allowed to accompany men.

B. Russia

Tea entered Russia around 1618 after a Chinese Ambassador signed a contract with the Russian Czar and brought tea on camel caravans across the Gobi desert and bartered with Russian fur.

C. Indonesia

In 1826 an attempt was made to start tea plantation in Indonesia with seeds imported from China and Japan, though an earlier attempt was made in 1728 which had failed. The success prompted the Nether land government, which was in power then, to import more seeds and workers from China, and plant tea in areas under their control. The yield was of poor quality and after subsequent failures, the government finally decided to abandon tea cultivation in 1860.

Some individual planters in Indonesia got inspired by the success in Assam and imported tea seeds from Assam in 1878, which proved to be the turning point for Indonesian tea industry. By the end of the century, tea industry was firmly established in Java. The industry began recovering in the mid –sixties, after it got a serious setback during the world war, and is now making steady progress.

D. Kenya

It is all very recent that tea has been established as a commercial enterprise in the country, but it has made quick success to become the largest among the tea growing countries in Africa, both in area and production. In Kenya planting is done at an average elevation of about 2000

meters and the tea estates are located on either side of the equator. Kenya is now making rapid expansion of the tea industry.

E. Western Countries

Tea entered America through Europe. The tea plant was first introduced to the Europeans by a famous Venetian writer on travels and voyages, Ramusio. Tea moved to America with the European groups migrating to the new colonies of North America. When the British government wanted to impose heavy import duties on tea to meet the expenses of the British Army and the government officials in America, the North American colonies protested. This led to the destruction of 340 tea chests sent by the East India Company at the Boston Harbour in 1773. The incident, popularly known as the Boston Tea Party, brought about an end to America's love for tea for centuries.

F. Tea in America

Today tea is a widely consumed beverage in America. According to the Tea Council of U.S.A. on any given day, nearly 27 million people- half of all Americans are drinking tea in different ways. With "ready- to- drink" and "gourmet" teas the tea industry in America is expected to grow faster (Source: The Website). **(Source: The Gourmet Retailer, Jan 1999)**

2.2 MANAGEMENT OF TEA PLANTATION

2.2.1 Management of Young Tea

Since the beginning of commercial tea cultivation all cultural practices have been aimed at maximization of harvestable shoots by manipulating bush frame to the desired shape and the technique involved in the process is termed as bringing up of young tea. The management of young tea is a very important part of tea cultivation and any mistake in this stage will have an effect on the productivity potential of the bush throughout its entire life period.

Land Preparation

Before deciding on any land as a prospective area for tea planting, the following should be checked very carefully. Soil should be tested for its suitability for tea- growing one year in advance. In virgin soil the trees should be killed one season ahead and clear the ground leaving the litter in site. Felling the dead trees and uprooting the stumps along with their root- system. Fill back the pits along with the excavated soil. Land should be leveled. The drains should be laid out and dug, excavated soil should be spread thinly over the ground, and if possible it should be removed from the site. (Photo 2.1)

In case of uprooted area, the land should be ploughed and cross ploughed up to a depth of 45 cm when it is moist, and sub soil where necessary, it should be taken care that lines of drain

Photo 2.1 : Land Preparation

shouldn't be ploughed. In case of highly acidic soils, broadcast 2-3 tones per hectare of finely powdered slaked lime before ploughing. The area is kept under rehabilitation for a period of 2 years with crops like Guatemala grass, Pusa Giant, Hybrid Napier, Citronella grass, Crotolaria anogyroides and Mimosa invisa, either singly or as mixture. If the growth of the rehabilitation crops is not satisfactory, rehabilitation period is extended for 1 more year.

Choice of Planting Material

Planting materials should be chosen carefully which are well suited to the region. In a tea garden a single clone/ jat should not normally exceed 10% of the estate area. Planting material which has high yield potential should only be used.

Density of population: There are basically two types of planting materials: having compact frame (e.g TV1, TV 14, TV 17, TV 27, TV 28, TA 17/ 1/ 54 and TS 449), having spreading frame (e.g TV 19, TV 20, TV 22, TV 23, TV 25, TV 26, S3A3, TS 462 and TS 463).

For optimum plant population: for compact frame: 16,000-17,000 plants/ha, for spreading frame: 14000-16000 plants/ha. Double hedge planting has an edge over single hedge for first 5-6 years single hedge has advantages in respect of frame formation, crop and convenience of cultural practices. However, to provide the best environment to each, bush spacing arrangement is most important. It is found that, minimum spacing required between plants is 60cm minimum spacing required between rows is 105 cm and approximately 5% of the area under plantation is occupied by drains, culverts, roads, paths etc.

Nursery Plants

Well grown, tall and healthy plant seedlings should only be used for planting. Following points are to be considered for selection of plants at the time of planting: - minimum stem thickness at the collar region: 0.5- 0.8 cm, height of the plant: 45-55 cm and maintenance foliage: 12- 16 leave/ plant. The soil in the sleeves should remain firm and intact with undamaged root system.

Photo 2.2 : Nursery Plant

Photo 2.3 : Plantation in the Field

Planting out in the field

While planting seedlings the top of the sleeve / bheti should remain flushed with the ground. In case of clonal plots, the mother leaf or leaf scar should remain slightly above the ground. After the planting has been done, proper ground leveling is very important. (Photo 2.3)

Mulching

There are many benefits of mulching. If mulching is for soil moisture conservation, then it must be completed by middle of November when the soil contains adequate moisture. Generally 10cm thick mulch requires approximately 15 tones of Guatemala lop pings per hectare. Water Hyacinth and Guatemala grass are the best mulching materials; any grass succulent vegetative material can also be used for the purpose. (Photo 2.4)

Photo 2.4 : Mulching

Table 2.2 Doses of NPK mixture per hectare

0 yr (Spring Planting)	: 200-400kg YTD (20-40 kg N)/ ha in 2-3 splits
+1yr	: 800- 1000 kg YTD (100-120 kg N)/ ha in 4 splits
+2yr	:1000 - 1200 kg YTD (100-120 kg N) / ha in 4 splits
+3yr	: 1200- 1400 kg YTD (120-140 kg N) / ha in splits
+4yr	: 140-150 kg N/ ha as 2:1:2 or 2:1:3 in 2 splits as strip application.
+5yr	: - do-

Staking

Before digging out pits for planting tea, bamboo pegs are normally used in the field to mark the position of the plants in order, so that the alignment of the bushes are in a straight line. This procedure is termed as 'staking'. Stakes are made of 40-50 cm tall split bamboo pegs. Staking may be done in two ways: staking in between the plants and staking at predetermined position of the plant.

Photo 2.5 : Young Shade Tree

Formation of bush frame

The most important aspect of young tea management is to induce proper bush architecture through a series of pruning to ensure that an extensive frame is formed for long sustained yield. At present this can be achieved in three stages:

(a) Decentering / lung pruning / Debudding

(b) Formative prune 20-26 months from planting

(c) Final frame forming prune

(a) Decentering**:** The main stem is removed at a height of about 20cm from the ground. This should be done when the plants are properly established in the field and at banji stage (4-6 months after planting). Root starch is considered important for recovery after decentering.

Lung pruning / thumb pruning: The well established plants can also be lung / thumb pruned with advantage. The procedure is that the main stem of the plant is held between the thumb and the index finger at a height of 20-23 cm from the ground and the stem is broken in

such a way that the skin on the unbroken side of the stem is left intact for nourishment by the plant. The broken portion is bent towards the ground facing either south or west depending on the situation. After sometime the broken portion will dry up and should be removed using a sharp small knife. Lung pruning can be done in the same way using a small knife instead of using fingers.

Debudding is another popular method of bringing up of young tea. The procedure is two weeks before debudding the top two and a bud should be tipped off from plants while in the nursery. This will help in swelling of the buds bellow. Four to five days before the plants are taken out to the field; all the growing buds are removed above 20-30 cm from the ground in the nursery itself.

(b) Formative prune: This prune is very important and should be given after 20-26 months from planting and at a height of 35/ 40 cm from the ground depending upon merit. The pruning stick should be at least 1 cm thick in the middle.

Photo 2.6 : Plucking of Tea

(c) Final frame forming prune: This prune should be given 5 cm above the previous prune after 24-36 months of first frame forming prune.

Shade

Importance of shade in tea was realized long ago but organized planting in tea plantations of North East India had started towards the end of the last century. The "Sau" tree (Albizzia

Chinensis) was the first shade species used for planting and later other species were included (Singh 9. D. 1996). (Photo 2.5)

1) Deep rooted shade trees help in conserving soil moisture during the moistures stress period. In drought prone areas like Terai shallow rooted species like a procera may compete for soil moisture.
2) Shade trees (A. Chinensis) and 2500 – 5000 Kg / ha organic matter to the soil annually by dropping leaves, twigs and pods. The nutrients contents of this added organic matter are :

N	=	63 Kg -	126 Kg / ha
P_2O_5	=	18 Kg -	36 Kg / ha
K_2O	=	22 Kg -	44 Kg / ha
CaO	=	32 Kg -	64 Kg / ha

3) Under A. Chinensis shade trees, feeder roots of tea develop at a higher rate than without shade.
4) April to October is the major growing season in Terai leaf temperature during this period varies between 30°C and 45°C depending upon the presence of wind at ambient temperature of 30° to 32°C.
5) The leaf temperature of shaded remains 1°C to 2°C higher than the ambient temperature, whereas under unshaded condition the same may be 2°C to 12°C higher than the ambient temperature.
6) Photosynthetic activity in tea declines rapidly above 35°C leaf temperature and between 39° and 42° there is no net photosynthesis. The respiration will continue upto 48°C and leaf temperature above 48°C damages leaf tissues.
7) A large amount of harmful infra – red radiation is absorbed by the shade trees.
8) Shading increases yield.
9) The positive effect of shade cannot be replaced by additional application of nutrients.
10) A shades species which is composed of a single layer of canopy of small leaflets, which will allow sunlight in the form of sunflecks and will cut off about 50 percent of the total available sunlight is considered the best. Albizzia Chineneis meet these requirement to the best.

Choice of Species

a) Temporary Shade species spacing

4 x 4m – 625 / ha (N – S hedge)

Species like Indigofera teysmanu, Sesbania asgyptiaca, leucaena, leucocephala, Melia axedarach can be used as temporary shades Gliricidia maculeata can also be used.

b) Semi Permanent Species spacing

6 x 6 – 275 / ha Albizzia Chinensis approximately 30,000 seeds / kg, albizzia falcataa (moluccana) 20,000 seeds / kg.

c) Permanent species spacing

12 x 12m – 68 / ha

Albizzia odoratissima	approx. 20,000 seeds / kg.
Albizzia lebbek	approx. 8,000 seeds / kg.
Albizzia procera (non-Droughty areas)	approx. 30,000 seeds / kg.
Derris robusta	approx. 35,000 seeds / kg.
Acacia lenticularis	approx. 27,000 seeds / kg.
Dalbergia Sercia	approx. 45,000 seeds / kg
Adenanthra pavonina	approx. 8,000 seeds / kg

Shade nurseries

A bed 120 cm x 30 m holds

2000 tubes of 20 x 45 cm size and 300 gauge for short term;

1600 tubes of 30 x 60 size and 300 gauge for long term

Soil : Light, eelworm tested, limited to pH 6 – 7, conditions with dry cowdung or compost, mix 1 kg single super phosphate or 250g DCP and 0.5 kg lime or dolomite with each m3 soil.

Seeding : Moister top of sleeves with 0.5 litre Endosulfan in 200 litres of water. Place 3 seeds 1 -2 cm deep, keep best seedlings.

Drainage, irrigation and pest control. As for tea nursery.

Transplanting

Minimum size of seedling should be 30 cm taller than tea. Planting pit should be 90 cm deep, 75 cm in dia.

Panting mixture : 10 kg cowdung (dry)
0.5 kg superphosphate
0.5 kg lime or dolomite mixed with the soil in the pit.

Planting time : After spring rain to early summer.

Carrot Planting : Root cut to 60 cm

Stump Planting : Maximum collar diameter – 10 cm, seedlings pruned to 2m while still in nursery, cuts sealed.

Planting Pattern : To estate plan, mixed stands, minimum locally proven 4 species.

Shade maintenance

Pest control with high jet sprayer, thinning out according to canopy size, rotation by interlining and inter – planting, control of canopy by lopping lower branches, pollarding for controlled height.

Fertilizers

Primary Plant Nutrients

Primary plant nutrients may not be available in soil in sufficient quantities which is required for optimum development and yield and hence annual application is necessary.

Nitrogen (N) promotes quantity and speed of leaf growth. Phosphate (P^2O^5) promotes root growth.

Potash (K_2O) promotes vigour, helps metabolism, and imparts resistance.

Secondary Plant Nutrients

Calcium (Ca) is usually available in soil.

Magnesium (Mg) promotes, health, growth, Foliar application in high yielding teas.

Sulphur (S) is getting depleted in tea soils, hence there is need for soil application in weel drained teas.

Micro Nutrients

Among the various micro nutrients, Zinc has shown consistent response and is applied as regular practice in North East India, mainly in unpruned / skiffed teas. The deficiency in the soil and only foliar application of Zinc Sulphate at 1 to 2 percent (w/v) is used. Foliar applications of manganese, boron and molybdenum show varied response but they are not used as a regular practice.

Deficiency Symptoms

N	:	Pale or yellow colour, slow growth, fewer shoots, small leaves.
P_2O_5	:	Dull, small leaves, weak skin, slow development.
K2O	:	Thin white stem, folded small leaves, poor recovery from prune or drought, fair central growth with poor side branched.
Ca	:	When p4 value 4 ? pH
Mg	:	When pH value 4, also in droughty condition depicted by interveinal chlorosis as inverted "V".
S	:	Yellowing of upper leaves.
Trace elements	:	Discoloured leaves, curly leaf edges and stunted growth are general symptoms.

Zn	:	Sickle shaped leaves.
B	:	Rosetting of new growth.

Nutrients removed by harvest of tea

	N	P	K
Made tea contains	5 %	1 %	2 %
2000 Kg / ha crop removes	100 Kg	20 Kg	40 Kg
Loss if pruning litter is not left in section	100 Kg	20 Kg	60 Kg

Maintenance mixture (approximate) NPK 2 : 1 : 2 [for young tea]

For low potash soils NPK 2 : 1 : 3 [for young tea]

(B.C. Barbora 1996, The Planters Hand Book)

Foliar Nutrition

Foliar nutrition is considered as complementary to soil fertilization for promoting growth. Foliar nutrition is usually applied under stress condition (water logging or drought conditions) or coinciding with physiological changes in the bush. NPK 2 : 1 : 2 or 2 : 1 : 3 where potash status is low, @ 0.5 – 1 percent can be sprayed during this period at the following composition.

NPK mixture	2 : 1 : 2	2 : 1 : 3
Urea in Kg	39 Kg	32.8 Kg
Di-ammonium Phosphate	24 Kg	20.4 Kg
MOP in Kg	37 Kg	46.8 Kg.
Total in Kg	100 Kg	100.0 Kg

Weed Control

Weeds are the Plants out of place in agriculture field or in any vegetation. Weeds may cause 10–15 percent crop loss in tea and may remove upto 252 kg of soil nitrogen per hectare annually in young tea. If not controlled in time weeds can easily outgrow crop plants.

(Dutta A. K. Akotoky B and Bora K, Field Mangement 2001)

Weeds may be classified in several ways, depending on their life – span, ecological affinity, botanical family, edaphic condition, place of origin, number of cotyledom, etc. But the first and the second type of classification is of more importance to the tea growers. Based on the longevity of weed species they are classified in three groups –

Annuals, which are quick grower and complete their life cycle within one season. Setaria glauca, Papalum conjugetum etc. belong to this group.

Biennials complete their lives in two years. Such weeds are not very common in our region, eg Elephantoupus scaber.

Perennials live more than two years. Cynodan dactylon, Melastoma malabathricum.

For chemical control of weeds, they are categorized in two groups, monocots (grasses) and dicots (broad leaf weeds) while the monocots are the major problem in young tea areas, dicots create problem both for young tea as well as mature tea areas.

The critical period of weed growth on tea in this region, starto from April and continues up to September. Hence, controlling of weeds should be started from the beginning itself. If weed control does not start in early April it results in weed competition which will adversely affect the growth and yield of tea.

Choice of Herbicides

Pre – emergent herbicides

1. Apply on moist and clean ground
2. Diuron in tea above 3 years of age should be used.
3. Soil should not be disturbed after application or should not be applied on disturbed soils.
4. Use on sandy soils should be avoided.

Post – emergent herbicides

1. Applied on active growth stage.
2. Sickle tall weeds and apply on regrowth
3. Paraquat in young tea should be used with care.
4. Dalapon should not be used in tea below 3 years of age.

(Barbora A.C. Field Management Practices in Tea, 1996)

At present only seven herbicides are usually recommended for use in the tea plantations of Terai. Simazine, Diuron and Oxyfluorfen are pre – emergence herbicides and safe for tea at recommended doses. Herbicides like 2, 4 – D, Dalapon and Glyphosate are post – emergence ones which is recommended for selective use. Paraquat is a contact, broad spectrum post – emergence herbicide. For best results certain conditions are necessary for the herbicides to work effectively. These are :

Table 2.3 : Spray Volumes for different herbicides to cover uniform weed infestation of one hectare :

Types of herbicide	Time of application	Herbicide(s)	Spray Vol (1 Lt./ha) in Lts.
Contact	Post – emergence	Paraquat	450 – 500
Contact + translocated	Post – emergence	a. Paraquat + Diuron b. Paraquat + Simazine c. Paraquat + 2,4 – D	450 – 500 450 – 500 450 – 500
Translocated	Post – emergence	2, 4 – D, Dalapon, Glyphosate	350 – 400
Translocated	Pre – emergence	Diuron, Simazine, Oxyfluorfen	400 - 500

Herbicide Toxicity

Herbicides are quite safe of tea if applied as per remommendation Herbicide toxicity on tea may occur due to the following factors.

1) If herbicides are applied at higher rates than the recommended optimum.
2) Nondirected spraying
3) Spray drift
4) Leaching of soil – applied herbicides by heavy rains.
5) Age of tea plant.

Drainage Requirement in Tea

These lands are infested by high amount of seepage flow from the high lands (hills) and demand for a well designed drainage system. It should be at least 1.5m deep and must be located at a proper place. Their number will vary depending upon the lie of the land.

Another important problem in such areas, is the gully formation. The soil unconsolidated and friable becomes susceptible to erosion when deep drains are dug with steep side walls. The erosion triggers from the outfall end, at sharp bends, near a culvert, at weak patches along the drain profile. Precautions should be taken so that the gullies are not allowed to be formed. Wherever necessary the drains should be covered with vegetation to check the erosive velocity. A good outfall is the key to success of any drainage system. The outset should always be large enough to cater for the drainage discharge of the catchment and should have adequate drop to water level during monsoon to permit outflow of the drains.

(Bordoloi P. K. Field Management Practices in Tea 1996)

In source tea areas of the region it has been observed that either the outlet is inadequate in size or the drop is too little to permit outflow from the drain. During rainy season back flow also takes place at times. The restriction of outflow is mainly due to :

1. Inadequate size and number of culverts and roads and railway embankments passing through the estates.
2. Siltation of streams and rivers.
3. Blockade of outlet by local inhabitants for fishing, paddy cultivation etc.

If a suitable gravity outlet does not exist, then it may be thought for artificial outlet by pumping.

Pump Outlet

Pump outlet is an artificial outlet to be used when gravity flow is not possible. The size of the pump will depend upon the catchment are, rainfall and amount of outfall restriction.

The industry at present is using the high flow low head mixed flow pumps. The essential elements for pump drainage installation are a pump station, power unit (engine or electric motor), a reservoir, a sluice gate and may be an earthen bund. Usually the bund and the sluice gate prevent tea areas from inundation by the backflow.

Vertical Drainage

Here the drainage water is disposed of into a well penetrating through impervious layers into porous sub – strata. Drainage water is first collected in the shallow depression adjacent to down well and then it is allowed to fall into the well.

Drainage System Design Requirement

a) Outlet availability
b) Topography – including natural waterways and depressions.
c) Texture and soil profile.
d) Bridges, culverts, etc.
e) Distance to natural outlet.
f) Stages of outlet water during monsoon.
g) Elevation of lowest point to be drained.

A drainage system may fail due to inadequate outfall, poor design, improper construction of drains and its inadequate maintenance. The design of an open drainage system includes mainly the shape, size depth, bed gradient, side slope, alignment, junction, drain location, length of drain, drain spacing and drain construction.

Drain Construction

1. Proceed upgrade starting from the outlet.
2. Main drain should be dug first, which should be followed by sub – mains and then laterals.
3. Digging should be done in stages.
4. Excavated soil should be evenly distributed over the area or carried away.
5. Digging or forking up during cold weather.
6. In case of hume pipes, the bottom of the pipes should be embedded in the drain bed by atleast 15 to 20 cm. The pipe should be covered by Soil.
7. Placement of culvert at bends should be avoided.

Drain Maintenance

After the drainage system is installed it is important to maintain it properly for efficient functioning. In flat land, the drains should be kept absolutely free from weeds when the drain bed gradient is steep in some foot hill estates, allow the vegetation to grow on drain bed and side walls under regular sickling. During monsoon, the drainage system must function well for efficient drainage.

Irrigation Requirement

The sections of young tea with low moisture holding capacity are likely to suffer most from drought. Low capacity may be due to shallow rooting in case of very young plants or it may be due to the type of soil itself as in sandy areas. Thus first priority should be given to the newly planted young tea in the sandy areas and teas especially with south facing slopes. Attention should then be given to the remainder of 1year old tea before applying the same sequence of priorities to second year tea. Irrigation during the critical period of first two years in young plant's life in drought prone areas would produce healthier bushes and it should survive without further irrigation provided appropriate moisture conservation practices are allowed.

The optimum irrigation regime for young tea seems to be 50 to 75 mm (depending upon soil & site) at two weeks interval. The most critical period for survival of young tea (after autumn planting) is October to January and irrigation should, therefore, start from either second half of October or first half of November by latest. Irrigation should start when the soil has been dry for one and a half weeks. After the first irrigation, six or seven irrigation should follow depending on the time of first irrigation. Rainfall during November to January should not as a rule influence the irrigation regime unless heavy rainfall of 38-40 mm or so is recorded. After such falls the irrigation schedule may be interrupted for a few days during

which equipment can be overhauled. The area that was irrigated the day before the rain will need irrigation again in two weeks and that a delay of 2/3 days will upset the schedule and cause harmful water stress. The same schedule of irrigation can continue until April, but this will not be necessary if moisture conservation measures are applied; at the end of January equipment can be moved to the mature tea.

2.2.2 Management of Mature Tea

Pruning & Skiffing

Commercial tea production needs tender shoots. So the tea bush is to be maintained in its vegetative phase of growth. Pruning is an essential requirement for it. (Photo 2.7) If pruning is not done, growing species of the tea bushes gradually loose vigour and finally reach a stage when they loose the capacity to produce sufficient quantity of tender shoots. The result is decrease in the weight of shoots, increase in the number of banji shoots on the plucking surface and more and more lateral beds fail to produce pluck able shoots. If this is allowed further the tea bushes enter the reproductive phase of growth. At this stage pruning becomes necessary to remove small twigs and small shoots to regenerate a new set of branches which can sustain vigorous flushing activity in the bush. After certain years of cultivation, severe pruning may be necessary to reduce the load of unproductive wood and also to eliminate the disease and pest ridden branches from the bush frame so that the productive capacity of the bush can be restored (Field Management Practices in India J. Chakravartee & A.C Barbora).

Photo 2.7 : Prunning

Objectives of Pruning

The main objectives of pruning are:

(i) To check reproductive growth and provide stimulus for vegetative growth, especially for the production of tender shoots that constitute the crop.

(ii) To remove dead or unproductive wood and renew the actively growing branches which can support the maintenance foliage and flushing activity.

(iii) To control the height so that plucking operation can be done easily.

Requirements before Pruning

Pruning Programme and starch test (particularly in young tea and tea that has not been rested until dormancy) is done. Iodine crystals (3gm) and potassium iodine (6gm) in one liter water (or weak hospital iodine solution) is painted on a newly cut, pencil thick root. The darker the developing colour on the cut, the better the starch reserve. If pale or no colour, rest for starch build-up is required before pruning.

Pruning Administration

(i) Supply of measuring sticks.

(ii) Arrangements for sharp knives and sharpeners.

(iii) Cut should be parallel to slope of the ground.

(iv) Pruning litters to be preserved in situ as mulch.

(v) In case P and K are low, apply 20-40 kg/ha above normal dose for heavier prunes in spring before cut, then rest from mid- October. However, P & K status are already high in the soil, this extra dose may not be necessary.

(vi) Bitumen paint on large cuts.

(vii) Winter wash oil for demossing.

(viii) Caustic wash for frame cleaning: 12 kg washing soda (or 3 kg soda wash) and 4-6 kg quick lime in 200 liters of water.

(ix) Knife with 15cm blade should be used for light pruning youngish teas. For cleaning out operation a smaller knife of 7.5-10cm should be used

Types of Pruning

The different types of pruning done on tea are:

(1) Collar Prune (CP) – all above the ground portion is cut leaving upto a maximum of 10cm.When the bush frame becomes unproductive and root system is still healthy collar prune is generally done (The Planters Handbook).

(2) Heavy Prune/ Rejuvenation Prune (RP) - it is done to rejuvenate the bushes which have become old and contains an excessive amount of unproductive wood in their frame. In order to arrest the deterioration of some of the old and middle aged sections of tea. It is not a

substitute for uprooting and replanting. The height of heavy prune for rejuvenation should be 40 to 45 cm above ground in plains. The bushes should be rested for 6-8 weeks prior to pruning, but may not be necessary when pruning is done in August- Sept due to possible heavy infection from blister blight. In low elevation areas and in the plains, heavy prune should commence in October and be completed by November. At the time of pruning all bushes should be cut at the predetermined level and thereafter the diseased wood below the pruning level should be cut down to healthy wood. If the section is infected with Aglospara or Poria, the pruning should be dipped in a percent of solution of any approved copper fungicide after pruning the bush. All the big cuts should be properly polished and pasted within hours from pruning.

(3) Medium Pruning - medium pruning is done to:

(a) reduce the height of bush frame, so that it does not exceed 80cm(32 inches).

(b) remove knots & diseased woods.

(c) reduce the proportion of unproductive wood.

Medium Prune is done between 60 cm to 70 cm (20-80 inches). Medium Prune is best done from mid- December to end- January. In drought prone areas medium pruning should preferably be done in January.

In medium pruning the bushes should be cut- across at the predetermined height, followed by the removal of dead, diseased and damaged branches and knots. All large cuts should be treated with a protective bituminous paste, like Indopaste, within 24 hours of the cut cross. To prevent the branches from sun scorch, the branches may be lime- washed and covered with the pruning filter immediately after the prune.

(4) Height Reduction Prune (HRP): 70-75cm in plains only.

(5) Light Prune: This is a cut given 2.5cm to 5cm above the last prune level in order to renew the shoot system for more vigorous growth. In the plain it is given across a flat level. The height of cut above the last prune- level; is determined by the thickness of the wood intended to be pruned (ideal thickness 8-10mm in diameter) accordingly pruning heights may vary between 2.5cm to 5cm from the last prune level. If, at the time of pruning the wood is not suitably thick, pruning is postponed by a year or more.

(6) Deep Skiff (DS): When deep skiffing is done after a light prune, it is a cut given between the pruning and the tipping levels. For instance tea tipped at 20cm is deep skiffed at 10cm above the previous pruning level (Tea Culture D.N Barua).

Deep Skiffing after one or more years of level skiff is a cut midway between the pruning level and the height of the plucking table at the end of the season, provided not more than

25cm of growth is removed by the skiff. For instance if the plucking height at the end of the year is 30 cm above the pruning mark, the tea will be deep skiffed at 15cm.

(7) Level-of-skiff (LOS): This is a skiff done to level off the plucking table by removing any plucking stubs or old leaves that stick above the plucking surface. The height of the cut above the previous tipping level is determined by the rise of the plucking table in the course of the year.

(8) Medium Skiff: When done on light pruned tea tipped at 20cm or deep-skiffed tea tipped at 10cm, this will be a cut given at 15cm above the previous pruning mark or 5cm below the last year's tipping level.

Photo 2.8 : Medium Skiff

(9) Light Skiff (LS): This skiff is done at or within 1cm of the previous tipping level.

(10) Unprunned (UP): Untouched / leveled by hand.

(11) Cut across Prune (CA): Removal of one or more year's old wood leaving only 3-5cm with a slashing knife of 20-25cm length.

(12) Clean-out Prune (CL): Small snags and knots and unproductive shoots are cut following CA.

$$\underline{CA + CL = LP}$$

(13) Desnag Prune (DSN): Snags, knots and dead wood are cut out following MP etc and the cuts are smoothened.

(14) Decentre Prune: Cut-off the main stem at 15-22.5cm retaining 2/3 or more healthy laterals below in a young plant.

(15) Lung Prune: A partial cut for decenter, leaving connection between bottom and top shoot.

(16) Finger Prune: Like lung pruning, done by partial breaking of the stem.

Effect of Pruning/ Skiffing on Crop Productivity: Loss/Gain of crop depends upon the severity of cuts. The following percentage of crop loss /gain is normally associated with the type of prune as compared with unpruned.

Table 2.4 Effect of Pruning on Crop Productivity

Type of Prune/Skiff	Percentage loss of Crop
Medium Prune	60-70
Light Prune	30-35
Deep Skiff	10-15
Medium Skiff	5-10

Table 2.5 Effects of Time of Pruning on Yield

Month of light Pruning	Whole Season's Crop (In Percentage)	Gain/Loss (Percentage)
January	104	+4
February	94	-6
March	96	-4
April	76	-24
May	79	-21
June	66	-34
July	63	-37
August	73	-27
September	80	-20
October	77	-23
November	95	-5
December	100	

The effect of Monthly Pruning on Yield was studied at Tocklai in annual pruned tea taking December pruning as standard. The results are given in table 2.5.

Factors affecting Pruning Time

(a) Sun scorch danger

(b) Drought danger/blister danger

(c) Regrowth time desired

(d) Rest period required

Crop required.

Crop Distribution

(a) The high crop treatments like UP, LOS, LS, MS in that order increase the first flush.

(b) LP and MS increase the percentage harvest of major and back end crop.

(c) HRP, MP, Heavy Prune increase the percentage harvest in the autumn crop.

Table 2.6 Distribution of crops under different types of Pruning/ Skiffing

Type of Pruning/ Skiffing Period	*Percentage Distribution of Crop*				
	LP	**DS**	**MS**	**LS**	**UP**
1st Flush (February- April)	2	3	5	10	12
2nd Flush (May-June)	20	25	27	30	33
Rains Flush (July- September)	63	63	61	55	52
Back end (October- December)	15	9	7	5	3

The figures reveal that distribution of crop is directly influenced by the type of pruning/ skiffing done.

Pruning Cycle in the Study Area

A pruning cycle generally spreads over 3-4 years in the Terai region. The duration of a pruning cycle should be such that at the end of the cycle, the branches attain the desired thickness and are not excessively thick. Clones behave differently to various forms of pruning/ skiffing in a cycle depending upon the duration of the cycle. For proper distribution of crop, obtaining quality and renewal of vegetative phase of growth it is necessary to put a tea estate under a definite pruning cycle. **LP-UP-UP, LP-DS-UP, LP-UP-DS, LP-MS-DS, LP-UP-DS-UP.**

Choice of Planting Material

The choice of pruning cycle is largely governed by the following factors:

(a) Kinds of tea

(b) Age and vigour of the bushes

(c) Frame height of the bushes

(d) Presence of knotty horizon

(e) Bush hygiene

(f) Shade status.

(g) Availability of irrigation facilities.

(h) Soil texture

(i) Recurrence of drought.

(j) Availability of workers for plucking.

(k) Quality Parameters

(l) Factory capacity and proper infrastructure

(m)Incidence of pest and diseases

Tipping

Tipping is the first plucking operation done on the new shoots produced as a result of pruning. It serves to:

(1) Establish a flat level convenient for Plucking.

(2) Stimulate the axilliary buds on the primary shoots to grow into lateral shoots, and

(3) Regulate the density of the maintenance foliage.

Photo 2.9 : Tipping

Tipping And Plucking:

Assamica types are usually tipped at 20cm, whereas sinensis types are tipped at 15cm, from the general prune level. Shoots which have grown over the predetermined tipping height by at least one fully unfolded leaf are tipped. Tipping height may be measured from the ground level when the concerned prune- marks are not in good level. (Photo 2.9)

Tipping height follows pruning height:

LP : 20-26cm (Average ht of 5 leaves).

DS : 7-10 cm (Average ht of 2 leaves).

MS : 4-5 cm (Average ht of 1 leaf).

LS : at skiffing level to janam.

LOS : at skiffing level to janam.

UP : at last plucking level.

CP : 70-75cm.

RP : 25-35cm.

MP/ HRP: 25-30cm.

Plucking:

The subject of plucking can be discussed under the following heads:

(1) Maximization of harvest.

(2) Plucking System.

(3) Standard of Plucking.

(4) Plucking Round.

(5) Creep and breaking back.

(6) Banjhi Shoots.

(7) Mechanical Harvesting.

(8) Plucking under extraordinary situations.

(1) Maximization of Harvest:

(a) Role of Maintenance leaves: the leaves which are left on a tea bush below the tipping level and other leaves left during the course of plucking are known as maintenance leaves. The maintenance leaves provide carbohydrates to the developing shoots that are harvested as crop, since the young leaves of tea are inefficient producers of carbohydrates. The photosynthetic efficiency of the maintenance leaves is retained for about six months after which it declines and the leaves drop off after about 18 months (Mulky M.J Sharma V.S). A tea leaf does not attain full physiological efficiency until it has grown to half of its full size. An adequate

number of permanent leaves is essential for keeping up productivity and survival of a plucked tea bush.

(b) Regeneration of Shoots: Shoots on the plucking table arise from the buds remaining on the stub of a previously plucked shoot, from axilliary bud and also from a non plucked origin such as from the outgrowth of a (banjhi) bud (Barbora B.C). When a fully developed bud breaks open, after a period of time, first the outermost appendage breaks free and produces a cataphyll (janam) which is followed by the unfolding of a second cataphyll (janam). After this the tip of a new leaf becomes visible. This develops into a small blunt leaf which is termed the fish leaf 'Golpat'. The bud continues to unfold and normal leaves are produced which grow into mature leaves. (Photo 2.6)

After pruning, primaries arise from the dormant buds on the sticks. After the primary shoot has been tipped, new shoots arise from the axillary buds and these shoots are plucked when they grow above the tipping level. Plucking of the laterals again stimulates the production of new generation of shoots of the next higher order and the process continues.

(2) Plucking System: Usually varies according to the agro-climatic situation, which influences the rate of growth. The system of plucking is categorized into two:

Fish Leaf Plucking and Janam Plucking.

(a) Fish Leaf Plucking: Is practiced in areas where the growth is slow or the plant is plucked throughout the year (where there is no winter dormancy), as in South India. This is the most lenient system and involves standard plucking over the fish- leaf instead of the Janam.

(b) Standard Plucking: Standard Plucking is plucking all the growth on the plucking table leaving the Janams, buds and small one and a bud. This system has always produced high yield and is of good quality.

(c) Black Plucking: This means plucking all the growth on the plucking table except the Janam and buds. This system may be advantageously followed to produce finer shoots in the vigorously growing season, and to increase the yield of unpruned and medium skiffed tea.

(3) Standard of Plucking: Standard of plucking denotes the type of shoot harvested. Depending on this there may be 5 standards of Plucking.

Although fine plucking gives the best quality crop, but ultimately there will be a net loss in terms of cash, due to shortfall in production. On the other hand both medium and coarse plucking will increase the harvest but quality will deteriorate depending on the coarseness of the shoot.

Plucking season in the Terai may be broadly segregated into three periods i.e Spring (March-May), Rain (June- September) and Autumn (October- November) seasons. Black

Plucking may be practiced during early spring and /or late autumn while standard plucking may be done during rest part of the year. Since the valuation of crop is dependent on the season, and 2nd flush (early May) and late autumnal crop is valued more, combination of these systems of plucking will help achieving better profit.

(4) Plucking Round: The standard practice in Terai is to pluck strictly at seven days round throughout the year, but plucking interval may be extended to 8-10 days in early spring or end autumn, or shortened to 5-6 days during the monsoon periods, according to the quantity or quality requirement. Longer rounds involve heavier breaking back.

(5) Creep and Breaking Back: Leaves and stems projecting above the plucking surface of a plucked tea bush, and not suitable for manufacture, should be removed at the plucking surface. This operation is known as breaking- back. It is done to maintain a flat plucking surface. But breaking- back is generally a wasteful operation and the necessity for doing this should, at all times be reduced to the minimum.

(6) Banjhi Shoots: Banjhi shoots above the plucking surface present a special problem. If they are not plucked, they tend to make the bush surface uneven. If a single banjhi is left on the surface until the bud starts to grow again, this shoot is normally plucked at a higher level since the stem of such a shoot generally becomes very hard.

(7) Mechanical Plucking: During peak plucking season, which coincides with the cultivation time of other kharif crops, availability of labour becomes problematic for almost every estate, as a result proper plucking round could not be maintained and shoots get lengthened which results in loss of crop. To tide over the situation, use of mechanical aids for plucking particularly during peak season is gaining popularity.

(8) Plucking Under Extraordinary Situations (Drought): Unpruned tea suffers most from drought. In case drought prevails early in the season, damage to the shoots due to die back of tender shoots and plucking point with defoliation of maintenance foliage can be very severe. 'Step-up' or 'single leaf' plucking may have to be done under such s situation.

Blister Blight And Pest Attack: In case of severe blister blight in medium pruned and light pruned teas just before tipping, initial tipping is done at a lower measure so that only mature maintenance foliage is left in the bush below the tipping level. On control of the disease the plucking table can be raised to the predetermined level. In unpruned teas showing incidence of the disease, black plucking is essential for removal of tender shoots. In case of thrips and helopeltis attack, black plucking is also desirable.

Severe Hail Damage: Any pocket created by hail damage should be allowed to fill up and then plucked to the general level of the table. In case of severely affected bushes, the plucking table should be raised by one full leaf/ fish leaf.

2.3. SOIL MANAGEMENT IN TEA

Any particular soil where tea is grown is required to fulfil certain conditions for the plant to flourish and make its cultivation commercially viable. Mann (1935) have described tea soils of different countries and have analysed the characteristics of soils which can support healthy growth of tea. The parent rocks giving rise to the soils where tea is now cultivated are widely different. Extensive areas of tea in Assam lie on almost flat alluvial land of recent geological origin, washed down from the Himalayas and the other mountain ranges of this region by the Brahmaputra and its tributaries. Two special types of soil found in Cachar are the teelas which are small hillocks of sandstone and the bheels which are drained peats very rich in organic matter. Except the old alluvial 'Red Bank' soil, other alluvial soils of North Bengal are also of more recent geological origin. In the Terai region of North Bengal, tea tracts slope upwards towards the mountains but does not at any place rise to more than 300m above sea level. A large number of rivers flow swiftly through this region and the deposits left by these rivers in the past form the tea soils. The deposits are, therefore, characteristic of the geological nature of the hills through which the rivers flow. In Terai, there is no distinctive outcrop of the Red Bank soils. The soils throughout this area are coarse and sandy, getting stiffer farther away from the hills (Barua D.N 1998). Alluvial deposits occur also in the tea areas of Malawi. In, Darjiling, South India, Sri Lanka, Tanzania, Uganda and parts of Japan tea has been grown successfully on sedentary soils derived mostly from gneiss or granite. The sedentary tea soils of Russia and Turkey are based primarily on andesite. Tea soil of Indonesia, Kenya, parts of Japan and Tanzania are derived mainly from volcanic ash. (Barua D.N, 1989)

SOIL FERTILITY

Soil is a storehouse of all the essential elements in available form in the right proportions to enhance the plant growth. It also indicates the presence of micro-organisms, aerability as well as suitable physical (like texture and structure) and chemical (like pH) conditions of soil for crop growth (Saikia D.N 1969). The role of different factors that add to soil fertility are given below.

Though soil has all the major elements for plant growth, each element has different role to play in the plant system:

(1) Nitrogen (N): Nitrogen increases the vegetative growth specially leaves and makes them juicy. It increases the freshness and greenishness of leaves which increases the photosynthetic capacity and thus the yield. It is the life supporting material of the plant cell which constitutes – proteins, amino- acids, nucleic acids and protoplasm.

Deficiency of nitrogen can be understood from the pale yellow to light yellow colour of young leaves and stunted growth of the plant. In severe cases defoliation starts from lower leaves.

Photo 2.10 : Nutrients Deficiencies & Remedies

(2) Phosphate (P): It helps in production of root. It is essential for cell division and development of leaves. It provides energy for metabolic reactions.

In case of phosphate deficiency, the surface of the mature leaves become smooth, dark or blue green but the tips become yellow. This deficiency restricts root development.

(3) Potassium (K): It helps in frame development of tea plant. Potassium enhances the ability of the plant to resist some diseases, insect attacks and cold and other adverse conditions. It reduces loss of water from plant and this helps the plant to withstand and this helps the plant withstand drought better. The efficiency of soil applied nitrogen goes up in presence of potassium. Symptom of potash deficiency is thin stem but with longer internodes.

(4) Calcium (Ca): Calcium combines with protein and constitutes cell wall and affects its permeability. It neutralizes the organic acidic condition inside the plant. Excess of calcium is known to retard some plant diseases. With low supply of this element, plant roots die at tips or remain short or stubby which affects plant growth.

The symptoms of calcium deficiency are matured leaves curving downwards which is followed by marginal scorch starting from leaf tip.

(5) Magnesium (Mg): It is an essential constituent of chlorophyll without which photosynthesis is impossible.

In case of magnesium deficiency, very distinctive interveinal chlorosis is observed with yellowish V- shape colour in lamina but veins remain green. This is in common winter months specially in Cambod origin plants.

(6) Sulphur (S): It promotes production of sulphur containing amino-acids, vitamin B 12 co-enzyme A, biotin, thiamine etc. It helps in the formation of oil and chlorophyll.

In sulphur deficient plant younger leaves become pale green to yellow like nitrogen deficient plant. Stems become stiff, woody and smaller in diameter.

(7) Zinc (Zn): It plays a role in protein and nuclei acid synthesis and helps in utilization of phosphorus and nitrogen in plants.

In case of Zinc deficiency, sickle shaped young leaves are developed due to unequal development of lamina on either side of the mid-rib. Leaves become smaller but darker. Internodes become shorter.

(8) Manganese (Mn): It increases the protein content in tea shoot. It has influence on formation of chloroplast, chlorophyll and photosynthesis.

In Mn deficiency, interveinal chlorosis of young and mature leaves occur with irregular mottling, vein and surrounding areas remain green. Severe deformations of young leaves and buds occur.

(9) Boron (B): It is essential for proper differentiation of tissues. It regulates K/Ca ratio in plant. It effects cell division and is essential for protein synthesis.

In boron deficiency the main shoot apices die, axillary buds abort and in their places cluster of small shoots appear. Leaves become dark green and thick. Corky layer appears in upper surface of leaf stalk.

(10) Molybdenum (Mo): It has a role to play in carbohydrate metabolism. Mo deficiency results in decreased concentration of sugar. The plants with this deficiency show interveinal chlorosis and mottling of lower leaves, which is followed by marginal necrosis and infolding. Lamina becomes abnormally dark green. The veins may show purple colouration.

(11) Iron (Fe): It directly plays a role in photosynthesis. The deficiency of iron leads to chlorosis of leaves and yellowing due to lack of chlorophyll.

(12) Copper (Cu): Copper promotes production of vitamin A in plant and is a component of many enzymes. Normally copper deficiency is not seen in tea. It's symptoms are yellowing of youngest leaves, curling of leaves etc.

(n) **Cobalt (C):** It is an essential component of Vitamin B 12.

Special Characteristics of Tea Soils

Mann (1935) agreed with Vageler (1933) that for successful culture of tea, the soil should not be less than 1.52 m (5ft) in depth. The surface soil as well as the sub soil should be fairly porous because the young, much – branched tea roots lack the power of penetrating stiff layers of soil. Where there is presence of a hard, impervious in the subsoil, such as an iron pan, is undesirable. However, a thin pan at a shallow depth can be broken up by deep ploughing when the land is prepared for planting tea. A well – designed network of drains, trencti planting and deep – rooting shade trees also help in breaking up shallow pans. The presence of a thick pan within the root zone makes the soil unsuitable for tea. Usually pan formation is uncommon under conditions of heavy rainfall. (Barua D. N. 1989)

Tea bushes cannot grow well in soils where the ground watertable remains so high as to submerge a portion of the root system as well as in soggy soils where the soil pores are clogged. The optimum watertable depth, differs between soil types since the capillary rise of water is affected by size and arrangement of the soil particles. The optimum depth is also linked with the depth of penetration of the root system.

Under field conditions, the watertable does not remain stationary at a particular depth. It rises and falls depending on the presence or absence of rain. The fluctuation of the ground watertable is minimal in regions where rainfall is disturbed evenly throughout the year, but where heavy rain during a part of the year is followed by prolonged spells of dry weather, as in N.E. India, the range of variation of the water table depth is very wide. In the Terai region, the water table occasionally rises nearly to the surface in the summer season during periods of

heavy rain and drops for beyond the root zone of tea bushes during winter and early spring. (Barua D. N 1989). In such situations bushes get waterlogged during summer and suffer from drought during winter. It becomes very important to drain out the excess water from the soil during the time of heavy rain in order to restrict rise of the watertable above a certain critical height which appears to be around 90cm in the case of sandy loam soils of Terai and for tea bushes having shallow root systems. If the soil is not drainable, then it cannot be considered suitable for tea. Tea requires a soil which should not normally be less than 1.5 – 2.5 m deep. Both the top and the subsoil should be porous to allow the delicate tea roots to penetrate.

2.4 PATTERN OF OWNERSHIP AND MANAGEMENT

Earlier there were two types of ownership, one was by the British companies and other by some rich and elite classes. Three types of ownership of the tea gardens is noticed in the study area.

(a) **Private Limited Companies** - These types of companies do not have any sharing by government. There are many private shareholders in this group.

(b) **Proprietory** - This is the ownership of one company or one person shareholder.

(c) **The Public Sector Or Government Limited Company** - This type of ownership is totally dealt by the State Government or the Central Government directly.

Table 2.7 Pattern of ownership of the Tea Estates

P.S	Proprietory	Public Ltd.Co	Private Ltd.Co	Total
Phansidewa	1	7 (70 %)	3 (30 %)	11
Kharibari	-	3 (75 %)	1 (25 %)	4
Matigara	-	7 (77.78 %)	2 (22.22 %)	9
Kurseong	-		1 (100 %)	1
Total area (in %)	1 (2.33 %)	17 (72.09 %)	7 (25.58 %)	25 (100)

The table reveals the pattern of ownership of tea gardens under the 5 police stations. Out of a total of 19 tea gardens located under Naxalbari P.S, only 1 is in the proprietory Sector,

sharing 2.33 % of the total. The Public Ltd. Co. owned 4 tea gardens sharing 72.09 % and 25.58 % of the total ownership of the P.S.

Out of a total of 24 tea gardens, located under the other 4 P.S, there is no garden under Proprietory Sector. In the Kharibari P.S, Public Ltd. Co. having 3 tea gardens shared 75% and Private Ltd Co. having 1 tea garden shared 25% of the total. Matigara P.S has 7 tea gardens under Public Ltd. Co. and shared 77.78% and 2 tea gardens under Private Ltd. Co. shared 22.22% of the total. In the Kurseong P.S only 1 tea garden is under the Private ltd. Co.

The study reveals that the total area of the P.S under Proprietory Sector is negligible, 2.33%. An area of 25.58% is occupied by Private Ltd. Co. The largest area was occupied by Public Ltd. Co. 72.09%. It has been found that Terai Tea Industry is dominated by large tea holdings under Public Ltd. Companies.

2.4.1 TYPES OF MANAGEMENT IN THE TEA ESTATE

The management of a tea estate is revealed in the following table.

Table 2.8 : Management of a Tea Estate.

MANAGER	
FIELD	FACTORY
Deputy manager	Deputy manager
Sr. manager	Sr. manager
Asst. manager	Asst. manager
Gardenbabu	Workers(M+F+C)
Sardar	Withering(M+F)
Labour (M+F+C)	Rolling(M+F)
	Fermenting
	Weighing(Sorting)
	Cutting (C)
	Packing(M+C)

Plucking	Spraying and pruning	Drainage	Nursery	Weeding
(F+M)	(M)	(M)	(F+C)	(F+C)

(M)= Male ; (F)= Female; (C)= Child.

There is a distinct hierarchy in the work organization in tea plantation system. This hierarchy helps to maintain the class structure of workers and planters. Generally there are four categories of employees in the tea estates every category is assigned with different types of work, their status, wages are also different. These categories are management, staff , sub staff and worker.

Category 1: MANAGEMENT

The manager is on the top of the hierarchy in a tea garden. He is all in all in a tea estate. In a tea garden he is responsible for all types of work. He is the legal representative of the employer or the company. In some companies, there is a superintendent manager above the manager to supervise a group of gardens under one company. In this hierarchical organization the next lower rank consist of a few assistant managers. The number of assistant managers depends on the size of the garden. The duties of assistant managers are to assist the managers. In a tea estate the assistant managers are of two types (1) Assistant Manager Garden, (2) Assistant Manager Factory. Generally the assistant manager garden is normally given the charge of a division of the garden or a part of it. He is supposed to supervise the works of the labourers in his division or a part of it. The assistant manager factory is given the charge of the factory. Sometimes the large tea – estate may have the Middle Cadre Officer (M.C.O) or Junior Cadre Officer (J.C.O) as the link between the managers and the staff.

Category 2: STAFF

The staff category is just below the management category in the organizational hierarchy of a tea estate. Generally this category consists of office clerks , factory assistant and garden assistant. The factory assistant and garden assistant do not work in the offices. The duty of a factory assistant is to assist the assistant manager (factory). His counterpart in the garden, the garden assistant is also supposed to assist the assistant manager (garden). There are a number of clerks in the office of a tea estate, headed by the head clerk. The head clerk supervises the works in the office. He also handles the cash. Below him there are a number of clerks who are assigned with specific official jobs.

Category 3: SUB-STAFF

This category comes below the staff category. Sub staff are mainly supervisory staff and generally promoted from the rank of workers. But unlike the daily rated workers they are paid on monthly basis and their wages are slightly higher than that of daily rated workers.

In the sub-staff category, Munshi and Sardar are the highest designation in the garden and factory respectively. In the garden next to Munshi comes Chaprasi. The next rank after Chaprasi in the garden is Baidar. He is given the charge of a group of workers. He is the

group leader. He supervises the works of this work. Dafadar is one of the most important in a tea garden. He directly supervises the performance of the workers. He is the group leader. He supervises the works of this group. Dafadar is one of the most important post in a tea garden. He directly supervises the performance of the workers. He has to guide them at every step. Chowkidar and Paniwala are the next two posts after the Dafadar. There are a number of Chowkidar and Paniwalas in a tea garden. The Chowkidar is the watchman or guard of the tea estate. There are line Chowkidars also, who guard the labour lines and also convey managers orders to the workers. The Paniwalas duty is to carry drinking water to the worker while they are at work. In the factory the sub staff category is not so broad like that of the garden. Beside the factory Sardar tehre are Electrician and Fitters also. Beside all these there are other sub staff , such as Dawawala (health assistant) or the Pharmacist who helps the doctor in dispensing medicines. The drivers, cleaners of vehicles, gardeners, office peons are some other sub staffs in a tea estate.

Category 4: WORKER OR COOLIE

This is the fourth or the last category in the hierarchy of a tea estate. This category consists of factory workers and garden workers. They are the main force among the employees in a tea estate. They are directly related in tea production. These workers are of four types : -male, female, adolescent and children. Those who are above 18 years old are called male or female worker according to their sex, those who are within 14 to 16 years old are called children workers. In the tea estates in West Bengal, adult male, female, adolescent are paid equal wages. Children are paid half the wages of the former.

The factory workers do all the tea processing works in the factory, this includes withering of tea leaves to weighing and packing of prepared tea leaves. In the garden the workers have to do everything from preparation of soil to plucking of leaves. Generally the female workers are engaged in plucking as they are good pluckers in comparison to their male counterparts. The male workers do the heavier works hoeing and clearing undergrowth, pruning the bushes in winter, chopping down shade tree when required and so on. Children workers are given lighter works like removing creepers, parasites from bushes and also leaf plucking.

There is little scope of promotion from one category to another in the hierarchy in tea estate except from worker to sub staff. It is very rare that a staff gets promotion to management category and also from sub staff to a staff.

The ethnic composition of workers, staff and management is also different. The workers and the sub staff are of tribal and Nepalee origin. The staffs are generally Bengalee and those in management are generally Bengalee or non-Bengalee.

Conclusion

In India merchants of the East India Company were primarily responsible for the development of the trade and planting, which together comprised the tea industry. The Company built factories at Surat in 1608, Madras in 1639, Bombay in 1668 and Calcutta in 1690. From around 1715, the East India Company took complete control of the export trade of tea from China and held it till 1833. During this period of monopoly, tea developed as a popular drink not only in England but in the American Colonies too, which started becoming popular and wealthy.

The East India Company had its monopoly renewed from time to time by the British Government inspite of protests from other concerns who wished to trade in the east. In 1813, an Act was passed ending the Company monopoly of trade in India and in 1833 all trading privilege came to an end in China. That year marked a turning point in the history of tea industry. In 1858, the East India Company handed over its ruling functions in India to the British Government. After this period tea plantation of a large scale was introduced in India particularly in North East India. During the very beginning of the tea industry it was necessary to use the plant growing land properly. So it's important to discuss the landuse pattern in tea, which has been done in the next chapter.