# CHAPTER 14

# General Discussion

The entire work has been designed to understand different aspects of the weeds of Tea Gardens in Terai and hills of Darjiling district of West Bengal. The richness of the flora in general of the concerned area is well known and that has attracted the plant scientists and naturalists equally at least for the last three centuries.

The donation of the Darjiling Hills part of Sikkim to the British-Indian Government in February 1835 has initiated the exploitation of its green wealth. Construction of a motorable road, rail-line and the establishment of a sanatorium at Darjiling were the first few strikes of the axe of development.

Just four years later (in 1839) Chinese tea-plants were introduced in Darjiling Hills and a few years later in Terai and Duars. This single species has caused the removal of the original vegetation cover from numerous hills and occupied entire hill surfaces. Of course, there is no any doubt that these Tea Gardens have completely changed the economic scenario of the area. Darjiling Tea is now world-famous for its naturally produced aroma and is one of the leading earners of foreign currency to the country's exchequer.

## 14.1 Aspects of the Present Dissertation

It is now important to know that (i) how much is really the effects of tea plantations on the floristic diversity of the region; (ii) if any rare and/or endemic plant can still survive in Tea Garden environment; (iii) what are the plants actually growing inside Tea Gardens; (iv) determination or recognition of important weeds; (v) uses of weedy plants; (vi) dependence of Tea Garden workers on local vegetation, and (vii) controlling the growth of weeds in Tea Gardens.

All these inquiries have been checked through a number of studies and the results were presented and discussed in different chapters. Based on those accumulated data and realisation gained

through discussions, it now essential to understand and/or clarify the above mentioned basic ideas of the present dissertation.

### 14.2 Effects of Tea Gardens on the Floristic Diversity of the Region

Das (1995, 2002, 2004), Bhujel (1996), Bhujel & Das (2002) has discussed the floristic diversity of the region. And, based on all these and earlier studies Das (2005) provided an estimate for the flora of Darjiling [Table 1.1]. It is not possible to get an absolute floristic picture through sample survey but a realistic picture can be obtained.

The flora of Tea Garden areas has been presented in Chapter 6 of the present report. This data has now compared with the estimated flora for Darjiling district in Table 14.1.

**Table 14.1:** Comparison of the Flora of Tea Gardens of Darjiling with that of the numerical estimation for the flora of Darjiling (Das 2005).

| Area | TAXA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Algae | Fungi | Lichen | Bacteria & Virus | Bryo. | Pterido. | Gymnos. | Dicot. | Monocot. | TOTAL |
| **Darjiling District** | *No proper record* | *No proper record* | *No proper record* | *No proper record* | 200 | 250 | 12 | 2200 | 700 | **3662** |
| **Darjiling Tea Gardens** | *Not record -ed* | *Not record -ed* | *Not record -ed* | *Not record -ed* | *Not record -ed* | 82 | 03 | 591 | 142 | **818** |

#### 14.2.1 Lower non-vascular Taxa

Till date no any consolidated work has been done of these floristic groups like algae, fungi, lichens, bacteria & viruses and Bryophytes. These groups also were not considered for the present work. So, it is not possible to understand the effects on these groups. But the rampant uses of chemical fertilizers and pesticides certainly have some deleterious effects on these groups. And, it is realised that studies on these floristic groups should be taken up to understand the actual picture.

#### 14.2.2 Pteridophytes

The estimate for the district is 250 species of Pteridophytes. The present work has recorded only 82 (i.e. 32.8%) species. So, the Tea Garden habitat is not at all suitable for the normal growth of Pteridophytic plants. In fact, most of these plants are found growing in garden margins, i.e. along the paths and roads and if there is any left over patches.

#### 14.2.3 Gymnosperms

Only three species from three different genera covering two families have been recorded from the seven gardens under floristic survey. Again, none of these three plants are growing there

naturally. One [*Tsuga dumosa*] is purely ornamental, *Pinus roxburghii* is also ornamental but its timber is quite useful and *Cryptomeria japonica* has been planted purely for its good quality timber. Of these, the third species is an exotic. However, 12 species of Gymnosperms are known to grow naturally in the district. All such plants are either tree-like or are trees and are unsuitable for growing naturally inside Tea Gardens.

### 14.2.4 Angiosperms: Dicotyledons

Bhujel (1996) has recorded 1900 species & varieties of dicotyledonous plants with much emphasis on the hill region. And, the estimate for the district is 2200 species & varieties. But, the present work has recorded only 591 species & varieties of dicotyledonous plants from the Tea Garden areas. This is a dangerous situation. Sample area is not less. The total area of seven Tea Gardens is quite large enough and covering very wide altitudinal range. Even then only nearly 27% plants have been recorded.

### 14.2.5 Angiosperms: Monocotyledons

The situation is worse for this group and only little over 20% of the estimated 700 species have been recorded.

### 14.2.6 The overall picture

This picture can not be encouraging from the floristic points of view as Tea Gardens are covering really very wide areas and forming effective barrier for migration of most of the species of macrophytes. Low height dense and nearly continuous canopy, regular cleaning of weeds and overgrowth in non-plantation areas within garden, felling of trees, use of different chemicals, mulching practices etc are creating the environment quite unsuitable for the growth of most of the species of plants. For the tea-planters this must be treated as a very happy situation as they need to tackle a lesser number of weedy plants in their plantations.

The most affected habit groups include trees, climbers, geophytes, epiphytes and parasites. Except shade trees and saplings of very few trees this habit group of plant is completely missing from actual plantation areas. Climbers cover the upper surface of tea-bushes and directly affect the growth of tea-plants. So, these plants are eradicated from plantation areas with much higher priority. Probably the low height of tea-bushes makes them unsuitable for hosting the epiphytic plants.

The exception is the record of 82 species of pteridophytes and a good proportion of them are actually from plantation areas. Sometimes a thick mat of *Selaginella* found to develop on the

floor of the plantation. This low biomass plant effectively cover the soil surface and help in checking soil erosion. But these are very sensitive and are killed with the application of any one of the commonly used herbicides. - - Probably the rhizomes of ferns are not easily killed with herbicides when their foliage are damaged soon helped so many species in Tea Garden areas.

## 14.3 Endemic Plants

The endemic status of Darjiling flora is quite high, around 30% (Das 2004). Even in severely disturbed Tea Garden environment quite a good number of such plants are growing. These endemic plants are of different categories like Endemic to Darjiling Hills, Endemic to Darjiling & Sikkim, Endemic to Eastern Himalaya, Endemic to Darjiling & NE States of India, Endemic to Himalayas and Endemic to India.

Some of the common endemic plants recorded here include: *Persicaria microcephala, Begonia flaviflora, Elatostemma sikkimensis, Acer hookeri, Ajuga macrosperma, Asystasia macrocarpa, Beaumontia grandiflora, Neanotis gracilis, Pilea bracteosa, Piper chuvya, Rubia charaefolia, Rungia himalayensis, Sauropus quadrangularis, Stellaria sikkimensis, Strobillanthes thomsonii, Viola hookeri, Acer thomsonii, Actinodaphne sikkimensis, Aeschynanthes sikkimensis, Ampelocissus sikkimensis, Argyreia roxburghii, Begonia dioica, Cyclea bicristata, Eriobotrya petiolata, Hypericum hookerianum, Lithocarpus elegans, Morinda angustifolia, Pilea cordifolia, Piper sylvaticum, Psychitria erratica, Dioscorea deltoidea, Peliosanthes macrophylla*, etc.

The total number of endemic species recorded is over 50. However, some of those need further verification.

### 14.3 Plants actually growing inside Tea Gardens

A Tea Estate is generally a large area, divided into a number of sectors where plantatios are made. In between the plantations some amount of land remain open. Tea processing factories, ware houses, labour colony etc all are generally constructed inside the Estate. For the biodiversity concerned people, these open areas are very important because, a large number of plants those fail to grow inside the plantations they can grow in such places.

Except the planted shade trees, other species of trees can not be expected inside plantations. Most of the sciophytic herbaceous plants are growing there fighting with a large number of inhospitable habitat conditions. Some tree saplings are also found growing there escaping the dreadful eyes of garden managers but they remain mixed with tea-bushes maintaining the same height. Some common climbers like *Mikania micrantha, Lygodium flexuosum* etc are sometimes growing on

bushes. In hill gardns *Drymaria diandra* sometimes form a loose network on bushes. But, all these are regularly cleaned. So, the flora presented in Chapter 6 is actually recorded all plants growing inside Tea Estates including the open areas. Plants cultivated in ornamental gardens are not recorded in the present work.

If the Tea Plantation flora is considered in strict sense, then it will be limited to small herbaceous plants only.

**14.5 Important Weeds and their Uses**

Species of plants treated as weeds in the cultivation of a particular crop are not essentially be treated as all useless plants. Chapter 12 of the present report dealt with the useful plants those are recorded here as Tea Garden flora. Table 12.1 has recorded 137 species of plants those are growing in Tea Garden areas as useful plants. This is a very conservative list and majority of these plants are not only of common and wider use but are also regularly marketed. These include plants of edible, medicinal, fodder, ornamental, decorative, timber, busketry, and religious etc. importance. These are not regularly exploited from Tea Garden areas by the outside world as the plantations are treated with a large number of poisonous chemicals. But, Tea Garden workers quite often use these plants.

In addition to the list of useful plants, the Table 12.2 has presented a list of poisonous plants. Again, most of the poisonous plats are also useful in different ways. For the hills, the most common example may be the case of *Urtica dioica.* This wild nettle bears dangerous stinging hairs and cause unbearable irritations and allergic reaction if come in touch with human skin. But, its young twigs are sold in the market as vegetable with very good nutritional value. The plant is also used as a fodder for increasing milk output in cattle. Similar is the situation for *Girardinia diversifolia.* Apart from these, many of these plants are medicinally useful ones like *Datura* spp. The case of *Jatropha curcas* needs special mention. Consuming a few seeds will lead to the collapse and then to the death. But, the cultivation of this species is now promoted by the both state and central Governments as source of biodisel. The species is also known to have medicinal uses and as a hedge plant in fencing the crop fields.

So, both the tables, 12.1 & 12.2 recorded the plants which are all important plants and are all growing within the Tea Garden areas in Terai and hills of Darjiling. This is a direct evaluation of the Tea Garden weeds and proved that quite a large number of useful plants are growing in Tea Garden areas and can be exploited for human welfare and are not merely useless plants.

### 14.6 Dependence of Tea Garden Workers on Local Vegetation

Most of the Tea Garden workers are basically very poor people and are exploited by their employers with very low wages, poor rationing, bad accommodation and only minimum or no medical facilities. Again, a high proportion of them are tribal people but are the inheritors of rich traditional knowledge. Their poverty and miseries have forced them to survive with the aids of natural resources, judging or evaluating with their traditional knowledge. They are collecting numerous species of plants not only from the Tea Garden areas also from outside vegetation to meet up their daily requirements.

Chapter 13 dealing with the ethnobotany of Tea Garden workers has, in fact, recorded as much as 420 species of plants. This includes (i) 141 edible plants, (ii) 57 fodder, (iii) 15 fibre yielding plants, (iv) 49 decorative & ornamental plants, (v) 41 religious plants, (vi) 336 medicinal plants, (vii) nine dye yielding plants and (viii) 79 species with miscellaneous uses.

Many of these 427 species of plants has multipurpose use. *Prunus cerasoides* is used as edible (fruits), ornamental (whole plant), religious (branches), medicinal (fruit, stem, bark) and also of miscellaneous uses. Another small tree, *Oroxylum indicum* is used as edible, ornamental & decorative, religious, medicinal and also have other miscellaneous uses. Like these, many other recorded species have multipurpose uses.

### 14.7 Weed Control in Tea Gardens

The aim of a Tea Garden manager is to produce better tea in larger amount. They do not understand the importance of conserving biodiversity or the diversity index on an area. They know only one species that is *Camellia sinensis*. So, the garden managers try to kill all other plants growing inside the plantations and for that purpose the generally take the help of a class of chemicals generally referred as 'herbicides' or 'weedicides'.

The present work also tested the efficacies of three of these chemicals, namely 2, 4 – D, Glyphosate and Paraquat [Chapter 10] and found that all these can kill a large number of species efficiently. But, even after the regular uses of these chemicals in most of the gardens weeds are the major management concern.

This is possible due to two basic factors: (1) successful weeds are early flowering, that means, they are producing mature seeds within the intervals of two successive applications of herbicides,

which they generally use in four months interval; (2) arrival of new seeds and propagules from the wild vegetation outside the plantation areas.

But, to develop one most efficient method for weed eradication/ control, specially when use of hazardous chemicals are not liking by the society for this purpose, one need to know the phenology [Chapter 7] and reproductive potential [Chapter 9] of these plants.

### 14.8 Natural Perpetuation of Weedy Plants

Weedy plants need to maintain their population themselves. For this they adjusted their phenophases in such way so that they get proper opportunity to release mature seeds in the habitat before they are killed or die naturally. However, in most of the cases [Chapter 8] these plants follow the local climatic cycle. They try to avoid winter months for thei germination and vegetative growth. So, there will be less weeds in the plantation during winter but that is of no use. In most of the gardens bushes are kept in dormant condition by pruning their leafy branches.

Tea bushes start sprouting during late March to April, when a large number of weedy plants also start appearing. Gardens are regularly irrigated during dry months in spring and summer. Weeds also use this moisture for their appearance and growth.

### 14.9 Important Weeds of Tea in Terai and Hills of Darjiling

Through the phytosociological investigations as presented in Chapter 7, ten most important species of weeds (Table 7.66) has been determined, those are *Borreria alata, Drymaria diandra, Ageratum conyzoides, Oxalis corniculata, Borreria ocymoides, Ageratum houstonianum, Oplismenus compositus, Oplismenus burmanii, Digitaria ciliaris* and *Desmodium triflorum*. Of these, except *Desmodium triflorum* all others are distributed over a wide variation in climatic conditions.

It is important to understand the reproductive potential and reproductive strategies of these weeds and that has been attempted in Chapter 9. However, all ten weeds mentioned above are high reproducers with the production of very large number of seeds and their efficient dispersal. These plants distribute their seeds taking help from (i) air currents: *Ageratum conyzoides, Ageratum houstonianum, Oplismenus compositus, Oplismenus burmanii;* (ii) insects like ants: *Borreria alata, Borreria ocymoides, Oplismenus compositus, Oplismenus burmanii;* (iii) water: *Drymaria diandra, Oxalis corniculata, Borreria ocymoides, Borreria alata, Digitaria ciliari, Desmodium triflorum;* etc. In fact, the strategies for seed dispersal are very important. These plants produce

very small seeds, light in weight and take the help of different agencies for their dispersal. One efficient weed should take the help of more than one agency for this purpose.

So, the efficient weed may be characterised from the reproduction point of view in the following ways: (i) short life cycle, (ii) easy pollination, (iii) high seed production, (iv) high rate of germination, (v) high rate of seedling survivability, (vi) efficient dispersal of seeds, (vii) wide range of climatic tolerance, etc.

### 14.10 Similarities and Differences in Flora

Selected seven Tea Gardens for the present dissertation are located in two distinct zones. The first four gardens [*Hansqua Tea Estate, Kamalpur Tea Estate, Matigara Tea Estate* and *Mohurgong & Gulma Tea Estate*] are located in the rolling plains of Terai with very minor undulations. And, the second group is on the hills and the minimum elevation being the 1300 m. Three gardens are there in this category namely *Makaibari Tea Estate, Soom Tea Estate* and *Tamsong Tea Estate.* The first group of garden experience a tropical summer but a chilling winter and the second group located in sub-temperate and temperate regions which remain cool throughout the year and the winter is severe specially in Soom and Tamsong.

This clear difference in climatic regime is expected to support two different sets of plants. An analysis of the floras in these gardens shows that while there are some core tropical plants those are growing only in Terai gardens and some core temperate plants those are growing only in hill gardens, also there are a considerable number of species those are with quite broad ecological amplitude and are growing both in Terai and hill gardens. The number of this third group of plants is not less than 25.6% (as determined through the phytosociological analysis). This is due to (i) the contiguity of vegetation of Terai and hills of outer Himalayas specially when these hills receive very strong tropical sun round the year and the hills of Kurseong region (i.e. for Makaibari TE) is facing the hot plains of the country; and (ii) the vertical distribution of hill gardens is also considerable leading to their presence in comparatively warmer environment in lower reaches and cooler environment in upper reaches.

Due to the contiguity of vegetation in Terai and Duars located at the lap of the Himalayas at this region with the vegetation on hills, it is expected that upward and downward vertical movement of different floristic elements will be there leading to the gradual broadening of the environmental tolerances of such species specially in regard to the ambient temperature that is the most important controlling factor of the environment. The entire region receive quite high and well

distributed precipitation and maintain high percentage of atmospheric humidity round the year so, water relation can not be the controlling factor.

### 14.11 Tea Gardens and Biodiversity Conservation

Tea Gardens are responsible for the loss of region's biodiversity. Those have eradicated thousands of species of plants and animals from their home or only home. Das (1995) provided a short list of angiospermic climbers those have been extinct probably due to change in their habitat structure. The process is continuing today with a much higher rate. So, the protected areas in this region will somehow survive for some time with no corridor for the migration of their biological elements. This dangerous and will cause the destruction or death of our entire bulk of the biological wealth.

So, now it is important to involve all these Tea Gardens into the region's conservation activities. With proper modification of prevailing legislation, they may be forced to maintain conservation corridors through their gardens and may establish some *ex situ* conservatories through their collective efforts.