INTRODUCTION

0.1 Scope of study
Over exercise of "Nature" for creating man's own world has become a constant boomerang to his sheer existence, which, of late, has made many of us think of the right way of dealing with the environment. Though it is not desirable, albeit impossible, to put back the natural environment in its original position by halting the advancement of civilisation, there is a dire need to rethink the extent of our control over nature in order that the life-sustaining processes are not hampered for the sake of our own survival. Defilement of our environment has gone to such a critical stage where normal processes of natural environment have been greatly struck down. The time has now come when we must extend our conscious efforts to arrest the worsening situation by adopting protective measures so as to help the present day fragile eco-system to recover fast.

Mountain ecosystems are generally considered sensitive and, often due to lack of proper management of natural resources, these regions become easy targets of environmental degradation (Messerli & Ives, 1997). In the last three and half decades, the Himalayas, one of the youngest and most tectonically active mountain ranges, has become the focus of intense interest and research. In the past decades unchecked deforestation, faulty land use practices, increasing settlement, unregulated construction of roads and encroachment of forest lands for the creation of arable lands have caused adverse geo-ecological impact in the Himalayan Ranges (Ives & Messerli, 1989).

The Ryang Basin in the Darjiling Himalayas can be taken as an example of such a problem where indiscriminate deforestation and irrational land use has taken place leading to environmental catastrophes and jeopardising sustainable development. Mungpoo, the heart of the Ryang Basin, is the headquarter of Directorate of Cinchona and other Medicinal Plants. The Cinchona industry, in the past, has rendered a great and a glorious service to the cause of mankind, and particularly, to the cause of suffering humanity around this part of the globe. Unfortunately, today it is a sick industry. At present, the demand of Cinchona and its alkaloids have increased and we are spending our foreign
LOCATION MAP OF STUDY AREA

THE RYANG BASIN

DARJILING DISTRICT

FIG: 0.1
INTRODUCTION

exchange to import them. The problem under study is to throw some light on
the functionary and relevant details of the Directorate and more, to use it as a
tool to locate the ills that plague its commercial viability and, of course, to
explore a remedy, as may still be found. Here, a major emphasis has been
given to the geo-environmental aspect of the Ryang Basin. For every planning
we should consider a watershed as a basic unit because the basic natural
resource, like water, is limited by the water divide surrounding the watershed
and this definite amount of water affects the quality of the other resources like
land, soil, vegetation in their different aspects. So, for better management of
the resources and to harness optimum utility, the drainage basin should be
given more importance. Thus, in order to manage the existing resources of
Ryang Basin, namely, the physical and social environment suitable for
Cinchona cultivation, the Geo-environmental study of the Ryang Basin is
urgently required.

0.2 Location of the Study Area

The leaf shaped Ryang basin (Fig 0.1) comprises of an area of 63.64 sq. km. It is
bound by latitude 26°53'N to 27°N and longitude 88°17'E to 88°25'E falling in
the district of Darjiling, West Bengal, India. The total length of the river in the
study area is 14.82 km. Fig 0.2 gives the Perspective View of the study area. It is
the 3-D view of the terrain: the terrain has the same appearance as viewed
from an airplane. This data has been used for the preparation of different
maps.

0.3 Research objectives

Several precise and rational objectives have been followed for the proper
study of the highlighted problem in the study area-

- To understand the physical background and geomorphic attributes of
  the study area in connection with the plantation activities.
- To analyse the rationality in selection of land use and their temporal
  changes in connection with economy and society.
- To briefly describe the evolution of Cinchona Plantation in the Darjiling
  Hills.
- To bring out the reasons for the importance of the Cinchona industry.
A Perspective View of the Ryang Basin

DATA SOURCE: IRS P6 LISS III, DATE OF ACQUISITION: 26th JANUARY 2006

FIG: 0.2
INTRODUCTION

• To identify the ills of the industry at present.
• To study the renewed demand of Cinchona from health care sector mainly Malaria and other newer uses.
• To describe and evaluate the impact of Cinchona industry on the social and economic situation of Mungpoo and to investigate into the potentiality of Mungpoo as an attractive center for village eco-tourism.
• To study the ecology and environment of the Ryang Basin and to assess the degeneration that has resulted over time.
• To suggest a development plan for the industry and to improve the environmental and economic condition of the Ryang Basin.

0.4 Organisation of the Thesis

This thesis is divided into eight major chapters.

• Chapter I
  Provides the physical background of the study area.

• Chapter II
  Deals with the geomorphological background.

• Chapter III
  Analyses the land use of the study area.

• Chapter IV
  Undertakes the special study of Cinchona cultivation.

• Chapter V
  Deals with the special study of Mungpoo and puts forward the effect of plantation on the economic, social and cultural environment of Mungpoo.

• Chapter VI
  Examines the past history and re-emergence of Malaria.

• Chapter VII
  Deals with the problem of the study area.

• Chapter VIII
  Covers the EIA study for the Cinchona Plantation

Finally, the last part of the thesis offers some concrete recommendations about how to meet this challenge.
The View of Ryang Basin from Mungpoo

Plate 1
0.5 Research methodology

Research method refers to the operational technique of data collection. In order to study "Cinchona Cultivation vis-à-vis Propagation of Malaria - A Geo-Environmental Appraisal in the setting of the Ryang Basin" the methodology adopted by the present researcher is a rationalistic one and has been designed in three stages.

- **Pre-field method**

This includes collection of primary and secondary data on the respective issue from different Government and non-Government institutions. To get a thorough knowledge of the study area, different libraries like the Departmental (Geography) Library of the Calcutta University, National Library, National Atlas & Thematic Mapping Organisation, Forest Departments, Geological Survey of India were consulted. To understand the areal dimension of the study area, systematic mapping of the area of study has been made from the Survey of India Topographical map no. 78 B/5, 1:50,000 (1972 & 1987). The SOI Topographical sheet was referred to get a view about the landform configuration and drainage network of the study area. Besides, information was also collected from Census Reports, District Census, Handbooks, District Gazetteers, Economic Reviews, Statistical Abstracts, Reports of District Annual Plan and also a number of relevant literatures.

For the historical over-view of the Cinchona industry the researcher had to rely mainly on the secondary sources like books, records, journal articles, news articles from local newspaper, websites, etc. The sources from where these records were available are National Library of Kolkata, Directorate of Cinchona industry, Mungpoo and Directorate's sales office at Kolkata. Apart from archival materials – different maps have been obtained from other books and journals. However, once the materials were collected the relevant matter had to be scrutinised and carefully presented in order to give a detailed historical perspective of the development of Cinchona industry in West Bengal. To understand the problem of Cinchona industry and why it is a sick industry today, various reports, drafts, official records were studied. For the latest development, some reliable online articles were also consulted. To understand the epidemiological situation of malaria in India and in West Bengal the Deputy Director of Health Services (Malaria), Kolkata was visited a number of times.
• Field method

Field observation involves qualitative as well as quantitative methods of data acquisition. The researcher had visited all the plantations of the Directorate several times to get a proper view of the industry. The researcher had also met the Deputy Director to have a clear picture about the present scenario of the industry. To study the socio-economic condition of Mungpoo, a case study approach was chosen as the main methodological strategy. A case study approach enables use of the inductive method, where general conclusions may be drawn from particular facts. Interviews, non-participant observation, group discussion and story narration were employed for obtaining the primary data here. The land use and landslide maps of 2002 and 2006 have been prepared from satellite images. A change detection study of land use from 1972 to 2006 and 2002 to 2006 are carried on here. The Valukup landslide is studied in detail in April 2003 and in May 2005 to understand the change in morphology of the landslide scar. Soils collected from the field have been analysed in the laboratory to find out the characteristics. To assess the environmental impact of Cinchona Industry, information was collected through a set of well-planned field questionnaires.

• Post-field method

The collected data, both primary and secondary, were processed, assimilated and analysed with the help of multiple methods such as tabulation and preparation of various types of charts. The tables enable us to reach to some conclusion and make certain comparisons. Besides this, they set a stage fit for analysing the data. Here, the data obtained from interviews and observations were classified by content categories. The data was then transferred into Microsoft Excel in the form of spreadsheets. Later, it was converted into tables and diagrams.

Landslides were mapped with the help of G.P.S. (Germin III, 9 channel) and maps were prepared with the help of GIS package such as Map-Info (Version 7), ERDAS IMAGINE (8.5) and ARC VIEW (3.2A). This helped to get a proper view of the highlighted problem and prospects of the study area and suggest a remedial measure. A suitable bibliography has also been prepared to show the references used.
Table 0.1
Materials and Methods for Study

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<td>Maps / Statistics from Government Departments</td>
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<td></td>
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<td>2. Topographical Sheet 78 B/5 – 1987</td>
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<td>3. Geological Map</td>
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<td>4. Meteorological Information</td>
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<td>5. Cinchona Plantation Maps</td>
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<td>6. Information Regarding Malaria</td>
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<td>7. Tourism Information</td>
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<td>8. Import Data of Quinine &amp; its associated Products</td>
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<td>Dept. of Tourism, Darjiling</td>
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<td>Questionnaire Self Generated (Table II Appendix)</td>
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</tbody>
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**0.6 Review of the Existing Literature**

Ryang Basin in the Darjiling Himalayas is a place of cultural and economic heritage and that of academic interest. This area is too often disturbed by
various environmental catastrophes. This region has encouraged intensive study and investigation by various research groups, government authorities, renowned geologists and geographers. The physical condition, the climatic characteristics, the conditions of the forest cover, the present situation of the Cinchona industry, the causes and consequences of landslides etc. have all been studied in detail. A review of the existing literature is given below.

The geology of Darjiling district, with special reference to lithology, structure, presence of thrust plane, their impact on rock and soil stability, etc. are studied by Mallet (1874), Bose (1900), Garwood (1903), Auden (1936), Heim & Gansser (1939), Ghosh (1950), Nautiyal (1966), Singh (1971), Acharya (1972), Lahiri (1973), Wadia (1975) and Powde and Saha (1982). F.R. Mallet was the first to classify the metamorphic rocks into Daling Series and Darjiling Gneiss. The role of rainfall in shaping the hill-slope of Darjiling was mainly studied by Starkel (1968, 1970, 1972, 2000).

The systematic study of morphometry is done by a number of geomorphologists. Important among them are Chorley (1957, 1962), Carlson (1963), Carson (1966), Dury (1969), Faniran (1969), Horton (1970), Doornkamp and King (1971), Kumar (1975) etc. In 1965-66, S. Ray and S.B. Sensharma carried out detailed study of the slope pattern around Darjiling, thereby assigning each segment of slope its respective status in the accepted nomenclature of waxing, wanning and critical slope inclination. The role of each inclination in causing and guiding slides had been discussed and an attempt had been made to assign the degree of stability of the slope for engineering construction. For this purpose the authors had prepared a detailed isotan map of the Darjiling ridge.


The role of soil erosion and its dependency on slope steepness was studied by D’Souza and Morgan (1976). Middleton in 1930 showed that the rate of soil erosion depends on the quality of soil and mountain soil being less cohesive, is prone to more erosion.
The land use of hill slopes is considered as the most important factor of soil and slope stability. Moss (1968), Mathur (1977). The planning for land use on basis of soil and other physical and social factors are discussed by Davidson (1980). The proposal for land use according to soil and land potentiality was given by Fisher (1980) and Kotlar (1981). The management of watershed of similar type from adjacent areas or from other countries is consulted for getting experience for the present work. Some of the important works are Horton (1945), Chorley (1969), Gupta and Tejwani (1982), Biswas (1990) and Bhattacharya (1993).

The condition for the cultivation of medicinal plants and prospects of Cinchona are studied by Lama and Chatterjee (1977) and Nandi (1993). The various aspects of utilisation of Cinchona and allied bi-products are described by Aslam (1977), Chatterjee (1977, 1982), Rao (1982), Nandi and Chatterjee (1984). The functioning of Directorate of Cinchona of West-Bengal was analysed by Banerjee (2001) whereas that of Tamil Nadu was described by Doraswamy (1977). The prospect of export of Cinchona and probability of its income in foreign exchange is studied in details by Sitaram (1977) and a number of proposals were prescribed. Nandi and Chatterjee in 1991 highlighted on the trends and recent researches on medicinal plants mainly on Cinchona.

A sizeable number of works have been carried on since a long time on spatial conditions of Malaria outbreak, its character, spatial spread and effects by Rusell (1942), Prothero (1961), Meade (1977), Stevens (1977), Halstead (1980), Shell (1997) etc. Status of Malaria in India was studied by Sinton (1935) and Rusell and Menon (1942).


Landslide is perhaps the most hazardous among all the environmental catastrophes threatening the Darjiling Himalayan. It is also the most widely investigated phenomena. J.D. Hooker (1954) gave a systematic report for the first time on the landslides. In 1951, S.P. Nautiyal and K.K. Dutta were sent to Darjiling to study landslips on behalf of the Geological Survey. The mapping of
potential landslide zone was proposed by Aniya (1985) and the study of forest resources, its depletion, afforestation programme, social forestry etc. were made by Banerjee (1964), Ghosh (1964), Brown and Sheu (1975), Chatterjee (1977) and Gupta, Singh and Gupta (1991). Krishna (2002) carried out further extensive study on landslide management on the Himalayas.

In the present work, the impact assessment study is different in character because it investigates into the effect of an already established plantation work and which has been running since a long period. Yet, the following works are noteworthy for they encourage the researcher to acquire extended knowledge on this subject. A large number of Impact Assessment studies are made from time to time. The methods of such studies are discussed by Munn (1979), Bisset (1987), Biswas and Geping (1987), Qu Geping (1987), Trivedi and Raj (1997) and Maiti (2004). The investigation into the accuracy of such study was made by Bisset (1984). The procedure for identifying most affected element and most dangerous action through a priority scale by evaluation matrix was proposed by Leopold (1971) and Maiti (2004). The assessment of impact of plantation of the immediate surrounding environment was made by Nandi and Chatterjee (1991).

All these above studies which have backed the present work, have initiated this researcher to engage in a detailed study of the basin in a wholistic manner.

Reference:

by C.K. Atal and B.M. Kapur, Regional Research Laboratory, Jammu, India, pp. 54-60.


- **Banerjee, U.**, 1964: A Short Note on the Forests of Darjeeling District, West Bengal Forest Centenary Commemoration Volume, Govt. of West Bengal, pp. 91-95.


Environmental Impact Assessment for Developing Countries, Tycooly International, London, pp. 5-64.


- **Bose, P.N.**, 1889-1890: The Darjeeling Coal between the Lish and the Ramthi rivers, Records of the Geology.


• **Doraswamy, K.**, 1977: Seven Years Working Plan of Tamil Nadu Cinchona Department, Government of Tamil Nadu, India.


• Hehir, P., 1927: Malaria in India, Oxford University Press, London, United Kingdom.


• Jain S.K., 1968: Medicinal Plants, National Book Trust of India, New Delhi, India.

• James, S.P., 1920: Malaria at Home and Abroad, Bale and Danieson, London, United Kingdom.


• Jones, W.H.S., 1909: Malaria and Greek History, Manchester University Press, Manchester, United Kingdom.


• Lahiri, S., 1973: Some observations on Structure and Metamorphism of the Rocks of Kurseong.


• Starkel, L., 1972: The Role of Catastrophic Rainfall in the Shaping of the Relief of the Lower Himalaya (Darjeeling Hills) Geographica Polonica, Vol.21, pp. 103-147.