

PREFACE

THE "Himalaya" is the name applied in ancient India to the great snowy mountain ranges where the snow remains throughout the year. It is regarded as the largest, youngest, loftiest and most fragile mountain systems in the world that stretches about 2500 km long and 240 to 340 km in breadth, and occupies an area of 2,36,000 km² in India. It was originated by the tectonic breakup of Gondwanaland and subsequent drift and collision of peninsular plate (Decan plateau) out of the bed of Tyeth Sea some 140 million years ago. It supports successively, subtropical, temperate, subalpine and alpine vegetation in response to increasing elevation.

Seasonal animal migration between alpine meadows and lower elevation forested areas is a common strategy for securing sufficient forage for grazing animals in the Himalayan region. The Indian Himalayan alpine pastures cover an area of about 1.7 million hectares. The Himalaya supports 20 million cattle, 10 million buffaloes, 3 million sheep and 6 million goats. Sikkim Himalaya constitute around 3% of the Indian Himalayan geographical area and support more than 2,00,000 cattle, 3000 buffaloes, 16,300 sheep, 1,15,000 goats, 5400 yaks & dzos and 1800 horses. There has been an observable sign of deterioration of Himalayan pastures due to overgrazing in the past few decades and management of these pastures has become a major issue. As far as livestock grazing is concerned, there has been no report available for the Sikkim Himalaya. Scientific baseline information data on livestock grazing and its causative effect on pasture health are prior need in formulation of grazing management regime. The present thesis deals with livestock-agroforestry-rangeland-tourism linkages in the Khangchendzonga Biosphere Reserve of Sikkim Himalaya.

The transformation of half-baked ideas into an acceptable form takes patience, time and more than a fair amount of good guidance. The culmination of my shaky ideas into a presentable forms owes much to the patience and guidance of my supervisors, Dr. Eklabya Sharma, FNASc, Scientist 'D' and Incharge, Sikkim-

Unit and Dr. R.C. Sundriyal, Scientist 'C' and Incharge, North-East Unit of G.B. Pant Institute of Himalayan Environment and Development (GBPIHED). Their judicious supervision straightened out many a convoluted concept I had, and trained me in a way of thinking I was unaware of. In spite of being preoccupied and busy with the other activities of the Institute, never failed to find time for discussion and data analysis of my thesis. I record my heartfelt gratitude to them. I have been highly benefited and this work has been streamlined from inputs received from Dr. L.M.S. Palni, Director, GBPIHED from time to time. His encouragement and interest in the work are tremendous that made me to work tirelessly.

The Mountain Institute (TMI) has facilitated the work along with the other collaborators of the Sikkim Biodiversity and Ecotourism (SBE) Project such as Travel Agents Association of Sikkim and The Green Circle.

I am grateful to Dr. S.C. Rai, Er. A.P. Krishna, Dr. K.K. Singh and Mr. L.K. Rai for encouragement and technical suggestions from time to time. Dr. (Mrs.) Rita Sharma and Ms. Alka Jain deserves special thanks for prompt and systematic support in laboratory analyses that has given me confidence in laboratory works. Mrs. Sabita Krishna always rendered cordial help while I needed books and literatures from the library. Mr. R.K. Das made me to work comfortably in the laboratory and office till late nights by providing office key. Dr. Pankaj Prasad, Mr. Ghanashyam Sharma, Mr. P.K. Tamang, Mr. Jagannath Dhakal, Mr. Shymbir, Mr. Mohan Thapa, Mr. Sunil Balmiki of GBPIHED cooperated with me during the course of work.

In the course of the work, I have had the opportunity to profitably interact with different experts and the discussions with them have helped me not only for the purpose of this thesis, but also in getting a better understanding of the subject. I gained much by having discussions with Dr. Sonam Paljor, Principal Director, Animal Husbandry and Veterinary Dept., Government of Sikkim; Prof. J.S. Singh, Banaras Hindu University, Varanasi; Prof. A.N. Purohit, Director High Altitude Plant Physiology Research Centre (HAPPRC), Garhwal; Prof. S.P. Singh, Head, Dept. of Botany, Kumaun University, Nainital; Prof. R.D. Gaur, Head, Department of Botany, H.N.B. Garhwal University, Garhwal; Drs. Rhodney Jackson and Alton Byer, Consultants, TMI; Drs. R.K. Maikhuri, G.C.S. Negi, Hem Rikhari, Dhruvat Chaudhury, Uma Sankar and T.C. Upreti of GBPIHED, Dr. M.C. Nautiyal, Senior Scientist, HAPPRC; Dr. Ajit Kumar, Salim Ali Centre, Coimbatore.

I am indebted to Mr. Renzino Lepcha, Project Officer of SBE for his ability to mobilize the local communities and graziers whose information was valuable in understanding livestock-rangeland-agriculture-tourism linkages. Mr. Nakul Chettri, Ms. Iyatta Maharana and Ms. Bidhya Pradhan of SBE Project are highly thankful for their cordial support and help. Mr. M.V.S. Manian's help in computer works made do away fear of handling computers. I would like to record my special thanks to Mr. Bhanu R. Sharma, who always assisted me during the field study trips, without his support it would have been difficult for me to conduct tough trekking at the high altitude sites.

Thanks are due to Ms. Doma and Kanchha of Tshoka and Yuksam villages, respectively for climatic data recording at Tshoka and Dzongri. All the porters of Yuksam Block whose names are difficult to remember are thankful for successful installation of barbed wire fence enclosures at the difficult hilly slopes and long tiring trek to the high altitude mountain. Villagers of Yuksam and Tshoka provided me the data on livestock during my survey. Yak herders from the high altitude areas shared information on their livestock and grazing history at different pastures. I appreciate the caretakers of Tshoka and Dzongri trekkers' huts for accommodation facilities during my field study trips. Khangchendzonga Conservation Committee members provided me a good working atmosphere in the study area. Special thanks are due to Amla and family members of Yuksam village who always co-operated and encouraged during my study trips.

Special thanks are due to Dr. Nandita Jain, Program Manager and Dr. Gabriel Campbell, former Program Director, TMI (presently Director General of International Centre for Integrated Mountain Development) for excellent management and successful completion of the SBE Project in Sikkim, without their endeavor the project would not have been successful.

I take this opportunity to record my sincere appreciation to Mr. D.D. Sharma, former Chief Wildlife Warden and Mr. Gut Lepcha, former Field Director, Khangchendzonga National Park (now Khangchendzonga Biosphere Reserve), Forest Department, Government of Sikkim for giving me permission for the establishment of experimental study plots. Mrs. Phigu Bhutia, Incharge of the Wildlife Interpretation Centre, Yuksam, Government of Sikkim is thankful for providing me the data on the revenue generated from the pack animals and tourist trekkers in the Khangchendzonga Biosphere Reserve. Drs. A.S. Chauhan, P. Singh

and other officials of Botanical Survey of India, Sikkim Himalayan Circle provided herbarium consultation facilities, and I sincerely acknowledge for their support. (

I take the privilege of thanking Prof. J.S. Singh sincerely for sharing a large number of research articles. His support during my visit to BHU has been tremendous. Prof. Singh had been kind to visit my study area and provided critical inputs on research methodologies and concepts. Mr. S.K. Dubey, Research Scholar, Ecosystem and Analysis Laboratory, Banaras Hindu University is appreciated for sharing his hostel room during my literature survey visit in the Banaras Hindu University.

The librarians of the G.B. Pant Institute of Himalayan Environment and Development, Almorah, Ratan Tata Library, New Delhi, Banaras Hindu University, Varanasi and Kumaun University, Nainital allowed and extended help during library consultation.

The hospitality rendered by Dr. (Mrs.) Manju Sundriyal during my visit to Itanagar for manuscript checking was wonderful and I thankfully acknowledged for it. The homesick feeling during my four years of research outside my home state was antagonized by the homely atmosphere and hospitality rendered by aunty Mrs. Laxmi Surana and family members of Deorali and their love is unrecoverable in my life.

I record my indebtedness to my parents, sisters and relative who remained a source of constant inspiration throughout the study.

Lastly, I am thankful to the United States Agency for International Development under Biodiversity Conservation Network program and IDRC-Canada for sponsoring the work. Without the financial support from them, the present study would not have been initiated and completed.

Gangtok,
May 2000



(Huidrom Birkumar Singh)
GBPIHED, Sikkim Unit