1. Introduction
INTRODUCTION

Tropical tasar silkworm, Antheraea mylitta Drury is a polyphagous silk producing forest insect of commercial importance, but it has never been experimented in Uttarakhand to improve the livelihood earnings of the forest dependent people. Forest dependent people in many tropical and subtropical forest areas of Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, Odisha, Andhra Pradesh, Uttar Pradesh Maharashtra and touching the forest fringe area of West Bengal commercially rear the larvae of A. mylitta on different forestry host plants for small household income twice or thrice in a year (CSB, 2012).

1.1 Why to introduce tropical tasar silkworm rearing in Uttarakhand?

Uttarakhand is a forest rich state, but the way we are using our natural resources is not sustainable. Pressure has been increased on forests due to outcome of social, economical, and industrial development, coupled with demographical expansions. Secondly, according to Directorate of Economics & Statistics, Government of Uttarakhand, 6.207 Lakh families are living below the poverty line in forested areas of the state (DES, 2013). Therefore, improved livelihood delivery of the forests will have a direct effect in reducing poverty of a larger segment of the population (Kalirajan and Singh, 2006). Third, migration of the hill people to plains has been taking place since the British times (Verma, 2012), but its extent has been accelerated now.

In order to reduce the problem of growing poverty in forested area and to improve the forest conservation efforts of the government in Uttarakhand, we have to improve the livelihood delivery to forest dependents. Because, forests have both, the potentials and limitations with regard to poverty alleviation capabilities (Angelsen & Wunder, 2003). Unfortunately, the rural development strategies had often neglected forests because they are mistakenly viewed as being outside the mainstream of agricultural development (UNEP, 2011). High incidence of poverty in forested areas and high dependency of the poor people on forests suggest a leading role of forests in
poverty alleviation (FAO, 2012). Therefore, by building local capacity to manage forest resources, supporting livelihood development and income generating activities like forest based rearing of tropical tasar silkworm, *A. mylitta*, forestry sector can tackle poverty more effectively that may help to achieve the Millennium Development Goal of the United Nations (FAO, 2012).

Introduction of *A. mylitta* in tropical and subtropical forests of Uttarakhand can help in poverty alleviation and avoidance by serving as source of subsistence, seasonal gap filters, and safety nets as advocated by Sunderlin, *et al.* (2003). Further, generation of productive and gainful employment with decent working conditions on a sufficient scale to absorb the growing labour force is a critical element in twelfth Five Year Plan strategy to achieve the inclusive growth of Uttarakhand (Planning Commission, 2013), where introduction of forest based rearing of *A. mylitta* in Uttarakhand may be taken as a component.

After attaining statehood in 2000, the economic progress of Uttarakhand has increased from just over 3% per annum to 11% per annum; however, in sericulture sector, the progress is almost stagnated. In 2009-10, the total silk production of the state was 16.5 MT (CSB, 2010), whereas present silk production in 2012-13 is 16.47 MT (CSB, 2013). All the silk production of Uttarakhand is mainly contributed by mulberry silk, with nominal production of temperate Oak tasar silk, produced by *Antheraea proyei*, practiced in western sub-Himalayan range at 700-1500 m in Uttarakhand (Jolly, 1970). Introduction of *A. mylitta* in Uttarakhand will improve the silk production that will revitalise the sericulture scenario in Uttarakhand by adding one more variety of natural silk.

Present study on evaluation of *A. mylitta* on seven forest tree species will help in recommending the most suitable forest tree species for tropical tasar silkworm, *A. mylitta* in Uttarakhand that may be included in afforestation programmes and other plantation schemes under government sponsored schemes like MGNREGA for the upliftment of the rural communities in forested area of the state. The fellow land in Village Panchayat and degraded forest area can be diverted for plantation of selected forestry host plants, because plantation of mulberry, *Morus alba* for indoor rearing of mulberry silkworm, *Bombyx mori* to produce mulberry silk is not a forest activity
(MoEF, 2004). Therefore, the sericultural area where forestry can be associated is forest based rearing of tropical tasar silkworm, *A. mylitta*. Furthermore, the findings of this study would contribute to the advancement of knowledge, both basic and applied in the field of R&D of Indian *Vanya Silk* industry and will contribute to the conservation efforts of sericultural biodiversity in relatively new ecological niches of Uttarakhand.

1.2 How it will help in poverty alleviation and forest conservation issues?

Introduction of forest based rearing of *A. mylitta* in Uttarakhand may be helpful in two ways; *First*, to create a new livelihood opportunity for the poor families in forest fringe areas and *second* to improve the conservation of tropical and sub tropical forests of the state through this activity. In Uttarakhand, forest based rearing of *A. mylitta* can be an ideal livelihood avenue for forest dwellers due to its low gestation and high economic return. In addition, this forest-based activity will also help to address the regional disparity and would facilitate poverty alleviation in Uttarakhand.

*Secondly*, owing to inconsistent livelihood delivery of many traditional NTFPs in Uttarakhand, forest based rearing of *A. mylitta* can be an effective source of livelihood option.

*Third*, commercialization of forest-based insect enterprises can create employment opportunities for bulging youth population in the state (Census, 2011; NIC, 2012).

*Fourth*, it is also important that forest conservation plan should be socially, economically, and ecologically viable; and needs to be developed with an understanding of the relationship of people with their forests to reduce the poverty in forested area.

*Fifth*, studies have also indicated, if forest dependent people are associated with forest based rearing of tropical tasar silkworm, *A. mylitta*; this income generating activity links livelihood with forest conservation, and generates a viable model of collaborative forest management (CFM), where different stakeholders work together
as a coherent entity for unified goal of managing the forest for well-being of the poor people in forest fringe areas (Bhatia and Yousuf, 2013a; 2013b).

1.3 Prospects of tropical tasar silkworm rearing in Uttarakhand

It has been reported that the forestry host plants of *A. mylitta* are widely distributed up to an altitudinal range of < 2000 feet or 610 meters in tropical moist deciduous and tropical dry deciduous forest areas of the Uttarakhand (Thangavelu, 2004), but *A. mylitta* is not reported to be available in the region naturally. Further, different eco-races of *A. mylitta* are also reported to be thriving well up to an altitude range of 610 m in tropical moist and tropical dry deciduous forest areas (Rao and Yadav, 2004). Accordingly, 6368.7 km² of forests are distributed up to an altitudinal range of <610 meters in tropical moist deciduous and tropical dry deciduous forest area in Uttarakhand, which is 26% of its total forest cover (24,495 km²), can be explored for forest based rearing of *A. mylitta* in the state (Fig. 1.1). Further, in Uttarakhand, an area of 12 790.06 Km², which is 23.91% of its total geographical area, is wasteland (MoRD, 2013) that is suffering from various forms of land degradations. Out of this wasteland area, 989.77 Km² areas are distributed at the altitude range of < 610 meter having tropical moist deciduous and tropical dry deciduous forests conditions (Anonymous, 2011). This wasteland area of 989.77 Km² can be utilised for the development of forestry tasar food plants to introduce forest based rearing of tropical tasar silkworm, *A. mylitta*.

Furthermore, recognizing the role of Vanya silk in livelihood support to the poor families and contribution of this activity in forest conservation, Ministry of Environment and Forest, government of India issued guidelines for vanya silkworm rearing under Forest (Conservation) Act, 1980. According to this act, plantation of forest trees on which vanya silk worms could be reared without undertaking a monoculture plantation shall be treated as forestry activity. Provided that, such plantation do not involve any felling of the trees and while undertaking such plantations, at least three species are planted of which no single species covers more than 50% of the total planted area (MoEF, 2004). Inclusion of this ruling in Forest (Conservation) Act, 1980 will facilitate introduction of forest based rearing of tropical tasar silkworm, *A. mylitta* in Uttarakhand.
Fig. 1.1: Altitudinal Zones of Uttarakhand State

Prepared at Forest Informatics Division, Forest Research Institute, Dehradun (UK)

Altitude zone in meter

- 770 - 69 Suitable for growing of A. myrtillus
- 6001 - 6400
- 4501 - 5000
- 3001 - 4000
- 1601 - 2400
- 611 - 1600
Literature survey indicated that in spite of the huge availability of forestry host plants of *A. mylitta* in tropical forest areas of Uttarakhand, the feasibility of forest based commercial rearing of tropical tasar silkworm has never been tried earlier in this state. Being the first study on *A. mylitta* in Uttarakhand, this investigation is on the line of the recommendations of National workshop on *Vanya silk culture and forestry*, organized by Forest Research Institute (FRI), Dehra Dun and Central Silk Board (CSB), Bangalore on 21st – 22nd April 2003 in Dehra Dun. Secondly, present research work also fulfil the recommendations of National Workshop on *Potential and Strategies for Sustainable Development of Vanya silk in the Himalayan States*, jointly organized by the Directorate of Sericulture, Govt. of Uttarakhand and Central Silk Board, Bangalore on 8th-9th November 2004 in Dehra Dun. This workshop specifically recommended that Daba and Sukinda ecoraces of tropical tasar silkworm, *A. mylitta* should be tested on forestry host plants to identify the most suitable food plant(s) for its rearing in tropical forest areas of Uttarakhand.

In addition, *A. mylitta* can sustain in a wide range of climatic conditions (Suryanarayana and Srivastava, 2005). The survival of this Lepidopteran insect at the temperature range of 6°C to 42 °C has already been established in Surguja, Raigarh, and Bilaspur districts of Chhattisgarh state in Central India. However, understanding on the climate of a prospective habitat is critical to predict its manifestation on biological success of a new insect species to be introduced. Therefore, before taking up this study, we assessed the climatic suitability of experimental site at New Forest, Forest Research Institute (FRI), Dehra Dun by comparing its main weather variables with district Surguja of Chhattisgarh state, where *A. mylitta* is well established and forest dependent people are traditionally rearing its bivoltine Daba ecorace on different forestry host plants and taking two crops in a year for small house hold income. Analysis of the data by using Fisher’s *t* test indicates that there is no major climatic difference between Dehra Dun and Surguja, as none of the weather variables differ significantly. It was therefore, inferred that *A. mylitta* would not face any major ecological constraint in new ecological habitat of Uttarakhand (Bhatia and Yousuf 2013c).
Considering the consequence of enriched carbon dioxide in atmosphere, due to climate change in coming decades, many herbivorous insects will confront less nutritious host plants with lengthened larval period and greater mortality chances (Coviella and Trumble, 1999). Consequently, geographic distributions of some insects will shift with host-plants ranges that may influence their interactions with other insects and plants. Therefore, it can be predicted that in coming decades, *A. mylitta* may shift towards cooler habitat from subtropical forests of central India, where it is presently established.

1.4 Biogeography of *A. mylitta*

*Antheraea* species have built up different forms of ecological populations called “ecoraces” in all tropical moist deciduous, semi evergreens, dry deciduous and tropical dry deciduous forests in India (Rao, 2001) and till now sixty-four ecoraces (different forms of ecological populations) have been recorded (Rao *et al.*, 2003). Among different ecoraces, “Daba” of Chota Nagpur plateau in eastern India, “Raily” of district Bastar in Chhattisgarh state, “Sukinda” and “Bogai” of Odisha, “Sarihau” and “Laria” of Jharkhand, “Bhandara” of Maharashtra and “Andhra local” in Andhra Pradesh are the important commercial ecoraces of *A. mylitta* in India (Rao *et al.*, 2003).

The bio-ecological conditions of tropical tasar silk producing states in India are different having a large variation in flora and fauna. There are sixteen climatic forest type groups reported in India and *Antheraea* species have built up their population in all such forests. Owing to continuous insect-plant interaction, *A. mylitta* has opted to different food plants for its survival in different ecological habitats (Srivastava *et al.*, 2003). In nature, *A. mylitta* has opted forty-five forest tree species as primary, secondary and tertiary host plants (Srivastav and Thangavelu, 2005). *Shorea robusta*, *Terminalia arjuna* and *T. tomentosa* are primary forestry host plants, *Lagerstroemia parviflora*, *L. speciosa*, *T. chebula*, *T. bellirica*, *Syzygium cumini* and *Anogeissus latifolia* are the important secondary host trees (Suryanarayana *et al.*, 2005).
Depending on the biotic and abiotic factors, *A. mylitta* completes its life cycle twice or thrice in a year and accordingly, the race is recognised as bivoltine (BV) or trivoltine (TV). Daba (BV) and Sukinda (TV) are the most commercially exploited ecoraces of *A. mylitta* in India. *A. mylitta* occurs throughout a wide latitudinal range of 12 – 31º N latitude and 72 – 96º E longitude in varied agro climatic conditions (Jolly et al., 1968; Sengupta et al., 1993; Singh and Srivastava, 1997) and across this range, its voltinism and diapause behaviour also varied, based on climatic conditions especially photoperiod and altitude of the habitat (Thangavelu, 2000b). In certain species of insects, the number of brood per year is strictly constant throughout the whole range of distribution (Masaki, 1961). However in India, *A. mylitta* has been recorded to behave differently in different geographical conditions: it is single brooded in Similipal forests of Mayurbhanj district in Odisha; bivoltine in tropical forest areas of Chhattisgarh, Uttar Pradesh and trivoltine in hotter zones of Chhattisgarh, Madhya Pradesh, Jharkhand and Odisha.

1.5 Brief production process of *A. mylitta*

Production process of tropical tasar silk is divided into pre and post-cocoon sectors (Fig. 1.2). Pre-cocoon sector is forest-based and on-farm activities, dealing with protection and management of the forestry host plants for silkworm rearing to produce cocoons for raw silk production. However, reeling, spinning (yarn production from cocoons), and weaving are the post-cocoon and off-farm activities.

Tasar silk, an insect protein fibre of *A. mylitta* cocoon, marks class and excellence to the rich people; but for the poor families involved in rearing of this silkworm species on forestry host plants and the releers and weavers who finish it into textile materials; tropical tasar silk stands for a natural source of livelihood. Tropical tasar culture is a nature-based labour intensive industry in all its phases of the production chain that does not require any major capital investment or land ownership and is more suitable for women and children, living in forest fringe areas and in buffer zones around protected forests.

In addition to its rearing, *A. mylitta* also thrive naturally and tribal people collect cocoons in January when they are easily seen on leafless trees. One family can
Fig. 1.2: Production process of *A. mylitta*

- **Raising & maintenance of forestry host plants in forest fringe area**
  - Chawki garden for young age rearing
  - Production of silkworm seed

- **Indoor grainage operation to produce silkworm seed**
  - Private Gramner

- **On farm training of forest dwellers**
  - Forest based commercial rearing of *A. mylitta*
  - Nutrients addition to the forest floor by litter of larvae & leaf falls

- **Commercial reeling & spinning - women based profitable rural entrepreneurial activity**
  - Twisting and dyeing: cottage industry
  - Textile Weaving-industrial / rural entrepreneurial activity
  - Production of raw silk
  - Twisted waste materials
  - Ready to use dyed silk
  - Weaving waste for handicraft production
  - National export earning

- **Pruning/pollarding production of fuel wood**
  - Improvements in the livelihood of forest dependent people
  - Additional household earnings

- **Pupal waste as poultry/fish food material**
  - Involvement of women self help groups
  - Product diversification
  - Livelihood improvement of rural masses
at least earn INR 13 000.00 per annum through cultivation of tropical tasar silkworm in the forest (MoEF, 2004), and if integrated package of rearing is followed, this earning can be increased up to INR 21, 937.00 (Srivastav and Thangavelu, 2005). *A. mylitta* produces high quality natural silk that has some peerless qualities like controlling blood cholesterol, antibacterial functions, and UV absorption properties (Akai, 1998).

### 1.6 Forest based rearing of *A. mylitta* and forest ecosystem

Forest based silk products are generated through ecological interactions between wild silkworms and their host trees. Insects eating green leaves of trees in forests are an integral part of the forest ecosystem. Population build-up of insects is regulated by biotic, abiotic, density dependent, and density independent factors. If natural regulatory mechanisms like parasites, parasitoids, predators and pathogens are active, insects do not attain the status of pests and their population remains below the economic injury level. In natural forests, outbreaks of tasar silkworm have not been reported so far, because damage due to feeding by the larvae to the host plants is negligible. Therefore, the tasar silkworm being herbivores in forest is regarded as forestry component of the forest ecosystem (Bhandari, 2003).

Functionally, annual primary production is an indicator of healthy forest ecosystem and forest productivity is the function of leaf area index (LAI). However, relationship between LAI and photosynthesis is not linear, because due to self-shading some leaves of the tree canopy receive so little light that their rate of respiration exceeds the rate of photosynthesis, which declines the function of net primary production against LAI. High leaf availability and corresponding increase in gross photosynthesis at high leaf area index is offset by increased respiration (Odum, 1975).

Silkworms are reared on forest hosts trees in small compact patches at outskirts of the forests and host trees are used once a year for 30-60 days. Host tree suffers a temporary photosynthetic loss, but the total production of forest stand does not likely be affected, because foliage loss after silkworm feeding allows under story trees and other ground flora to get much light that compensates temporary photosynthetic loss of partially defoliated host tree. Secondly, after silkworms’
feeding, secondary foliage grows in 30-45 days and foliage losses are not only compensated, but the total LAI exceeds in comparison to the un-damaged trees. Third, the thickness of the secondary foliage is less than the primary foliage and has better photosynthetic efficiency in comparison to the older leaves, which were consumed by larvae of *A. mylitta*. Fourth, increased longevity of newly grown leaves on silkworms’ fed trees extends the usual leaf fall period and this extended period of leaf on crown provides a positive photosynthetic gain to the utilized forestry host plants. Therefore, as far as the foliage loss is concerned, new foliage offsets it and apparently, no loss takes place in annual primary production of the forest due to silkworm feeding. Bhandari (2003) reported that forest silkworms are forest insects and have no adverse effect on growth and increment of the forest.

1.7 Effect of rearing seasons and forestry host plants on *A. mylitta*

*A. mylitta* is a forest insect, but its biological success is influenced by the heterogeneity of its forestry host plants and climatic conditions of the habitat (Hunter *et al.*, 2000). Larvae of *A. mylitta* feed on many forest tree species, but always show great degree of selectivity as a function of their behavioural responses to physical structure and chemical features of forestry host plants, which are differing in nutrients’ profile and concentrations of wide variety of phagostimulants. Biological success of an insect herbivory can be influenced by variation in host plants quality and climatical induced changes. Variations in host plants can also have an influence on herbivorous populations through changes in rate of movement, mortality due to natural enemies, and rates of competition (Ojha and Panday, 2004).

The role of host plants, temperature, humidity, rainfall, and photoperiod on the growth and development of insects have clearly been demonstrated (Danilevskii, 1961; Tyshenko, 1977; Zaslavski, 1984; Tauber *et al.*, 1986; Danks, 1987). Seasons indicate the inter-annual variations in temperature, humidity, sunshine, rain fall etc. of a particular place and it is governed by different geographical parameters. Larval period, pupal and cocoon characters are also influenced by seasonal variations in tropical tasar silkworm, *A. mylitta* (Srivastava *et al.*, 1998), eri silk worm, *Phyllosamia ricini* (Kar *et al.*, 1998) and muga silk worm, *A. assama* (Sahu *et al.*, 1998).
Knowledge of the nutritional ecology of an insect is a pre-requisite to understand its biology and behaviour (Scriber and Slansky, 1981). There may be more than one optional food plants for an insect and the patterns of their consumption may be different, although foods are more or less similar in their ability to support growth (Dadd, 1960). Food plants affect the overall growth of silkworm and their ultimate effect is reflected on the eggs and silk production.

In Insects, relative growth rate is related to the capacity of food-intake (Rogers et al., 1977) and nutrients absorbed by the body from the food derived from different host plants (Sang, 1956; House, 1962; Bhatt and Bhattacharya, 1976; Deshmukh et al., 1977 and Joshi, 1984). The amount, rate, and quality of food consumed by a larva affect growth rate, developmental period, body weight, dispersal ability, and probably survival (Slansky and Scriber, 1985). This influence can also carry over to adult performance. When a larva suffers from poor growth, it produces small-sized adult with reduced fecundity. Host plant quality is a key determinant of the fecundity of herbivorous insects (Johanson, 1964), because a bit higher nutritional requirement was reported in female insect for reproduction in addition to the normal energy (Grison, 1947).

Forestry host plants of A. mylitta are known to differ greatly in their nutritional profiles that affect its larval growth and development (Kohli et al., 1969; Sinha and Jolly, 1971; Agarwal et al., 1980; Puri, 1994; Sinha et al., 2000). Therefore, evaluation of different forest tree species as food material in respect of the traits that contribute to the growth and development of A. mylitta are critical to assess their effects on different biological and economical variables of this silk producing insect in Uttarakhand. Since, it is the first study on tropical tasar silkworm in Uttarakhand, so the choice of forestry host plants has to be practical in respect of their availability in tropical forest areas of Uttarakhand. Accordingly, seven forest tree species viz., Terminalia arjuna, Terminalia tomentosa, Terminalia chebula, Lagerstroemia speciosa and Lagerstroemia tomentosa were chosen as host plants to test their suitability for rearing the A. mylitta. In Uttarakhand, these forest tree species are widely distributed up to an altitudinal of 610 meter in tropical moist deciduous and tropical dry deciduous forests in 6368.7 km² of forest
area, constituting 26% of the total forest cover of the state (Thangavelu, 2004; WMD, 2011; Anonymous, 2011).

Out of these host plants, *L. tomentosa* has been tested first time for the rearing of *A. mylitta*. Secondly, according to the botanists, *T. tomentosa* and *T. alata* are the same species, now called as *T. alata*. However, it was found in the experiments that *A. mylitta* performs quite differently on the leaves of *T. tomentosa* and *T. alata*, as both are differing in their physical and chemical parameters, so their influence on *A. mylitta* has been quantified for forty different parameters. Further, literature survey confirmed that *A. mylitta* has never been evaluated on above forest tree species for all the selected forty parameters in any part of India, which is a natural prerogative custodian of this lepidopteran insect in the whole world.

The literature on the response of insect species to the changing environments experienced along altitudinal gradients is diverse and widely dispersed. According to Wright (1952), understanding the nature of qualitative and quantitative variability in cultivated plants and animals in new geographical locality has primary importance. Because, most of the economical traits in the silkworm species that contribute to the silk yield are quantitative in nature and are under control of polygenic system, which exhibit variations in different environments (Chakravorty and Pandey, 2005). Therefore, any attempt to study the quantitative traits of *A. mylitta*, it requires not only proper understanding for selection of suitable race and its response, but also the extent of phenotypic expressions of the traits under given environmental conditions on different forestry host plants.

With a view to garner, the maximum productivity of tropical tasar silk per unit area in new agro climatic conditions of Uttarakhand, it was essential to concentrate research activities on qualitative and quantitative traits of *A. mylitta* on different forestry host plants, as the importance of local adaptability of silkworm species has been recognised by the scientists (Iyenger et al., 1993). For proper utilization of food by tropical tasar silkworm in new ecological habitat of Uttarakhand, it is important to study the effect of different host plants on overall growth and development of *A. mylitta* and its manifestation on cocoons, eggs, and silk production. Because nutritional efficacy of forestry host plants with regard to biological efficiency of *A.
mylitta may show a significant variation in new habitat due to their interactions with seasons and host plants.

Keeping this complex variability in view, an attempt has been made to evaluate the qualitative and quantitative economical traits of tropical tasar silkworm, *A. mylitta* on different host plants of forestry importance in Uttarakhand, where no such study was carried out earlier so far. In current study, effect of different forestry host plants, seasons of rearing and their interactions on forty parameters of *Antheraea mylitta* Drury have been investigated. Seven forest tree species, each in six replicates were tested as food plants, and four crops were taken during 2012 and 2013. This study focuses on all the functional and economical aspects of *A. mylitta* that show a positive or negative reaction on different forestry host plants in different seasons. The manifestations in which these factors individually and collectively influence the larval and cocoon biometrics, larval and adult behaviour, growth and development, survival and reproduction of *A. mylitta* are considered in detail. In addition, effects of host plants, rearing seasons and their interactions on parasitic behaviour of *Xanthopimpla pedator* on *A. mylitta* were also studied, as the influence of these factors on biological success of *X. pedator* was not known.

1.8 Objectives of the study

The broad objective of this study is to explore the possibility for field rearing of tropical tasar silkworm, *A. mylitta* in Dehra Dun, Uttarakhand to promote its adoption by the State Forest Department and by the tribals and rural communities inhabiting in forest fringe areas to improve their economic condition. Therefore, the objectives of this study are as under:

1) **To study the suitability of different forest tree species as food plants for the development of silkworm, *Antheraea mylitta* Drury in Uttarakhand.**

2) **To study the reproductive potential of *Antheraea mylitta* Drury reared on different forest host plants in Uttarakhand.**

3) **To examine the economic traits of cocoons and silk production efficiency of *Antheraea mylitta* Drury reared on different forest tree species in Uttarakhand.**