SITE SUITABILITY ANALYSIS USING GEOSPATIAL TECHNIQUES FOR IDENTIFICATION OF MULBERRY PLANTATION SITES: A CASE STUDY OF DEHRADUN DISTRICT OF UTTARAKHAND STATE

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ABSTRACT

Site suitability analysis has been done to identify and map the potential areas for mulberry cultivation on 1:50000 scale in Dehradun district in Uttarakhand state. Cultivable wasteland was taken as the potential areas for suitability analysis. Different thematic layers viz., cultivable wasteland, forest cover map, soils (depth, drainage, texture), slope, elevation, ground water prospects, have been generated and incorporated with climatic parameters (Temperature, rainfall and humidity) to derive different site suitability classes using Resourcesat 1 LISS III satellite data for mulberry plantation in Dehradun district. The study has identified suitable areas for mulberry plantation in Dehradun district. Identified suitable areas can be taken for mulberry plantation by the sericulture department to meet the increasing demand of silk production using present wastelands.

Key Words: Sericulture, Site suitability, RS & GIS and Meteorological factors.

INTRODUCTION

Since antiquity, silk and silk fabrics have fascinated mankind and have found their place among the most prized and graceful human fabrics. India is the second largest producer of silk in the world with the distinction of producing all the five varieties of commercial silk. This sector has tremendous export potential due to high demand.

Sericulture is the art of silk production and broadly comprises inter-linked activities such as food plant cultivation, silkworm rearing to produce the silk cocoons, reeling the cocoons for unwinding the silk filament, yarn making, weaving and processing of fabric. It suits both marginal and small-scale landholder because of its small investment, high assured returns, short gestation period and ample opportunities for improvement of income and creation of family employment round the year. Being a cottage industry it provides ample work for the women in rural areas, while their male counterparts look after agriculture. Silk worm being delicate has to be handled with care. Thus, the entire process needs skill and patience, which suits women well.

Sericulture has several bye products besides silk. The mulberry fruits are rich in minerals and vitamins and from the roots, barks and mulberry leaves several ayurvedic medicines are prepared. Some of the woody mulberry trees provide timber which are resistant to termites and the timber is used for making sports items, toys etc. The foliage of mulberry is used as a fodder for cattle. The mulberry trees are also planted in the embankment area for protection of the soil to prevent soil erosion, and mulberry trees are planted as avenue trees. The silkworm pupae are rich in oil content and pupal oil is used in cosmetic industry and the remaining pupal cake is a rich source of protein suitable for poultry and fisheries.

Uttarakhand is the only state in India (perhaps one of the few regions in the world) which has the favourable agro-climatic conditions to produce all 5 varieties of silk i.e. temperate and tropical Tasar, Muga, Eri and Mulberry silk [1]. It also have well developed network of sericulture societies, Self Help Groups, NGOs etc with availability of cocoon markets and reeling units. Sericulture provides productive employment , economic development and improvement in the quality of life to the people in rural areas and therefore plays an important role in anti poverty programs and prevents migration of rural people to urban area in search of employment which is the major problem in Uttarakhand state. It also helps in women empowerment which is critical for all round development.

Geospatial techniques can play critical role in mapping the suitable areas for mulberry cultivation in non-traditional states like Uttarakhand. These were earlier used to map the existing and potential areas under sericulture at 1:250,000 scale in different parts of India. This has been used in the present study for preparation of different thematic maps and GIS for spatial analysis to find out the suitable areas at 1:50,000 scale.

OBJECTIVE OF THE STUDY

The main objective of the study is to identify suitable areas for mulberry plantation in Dehradun district.
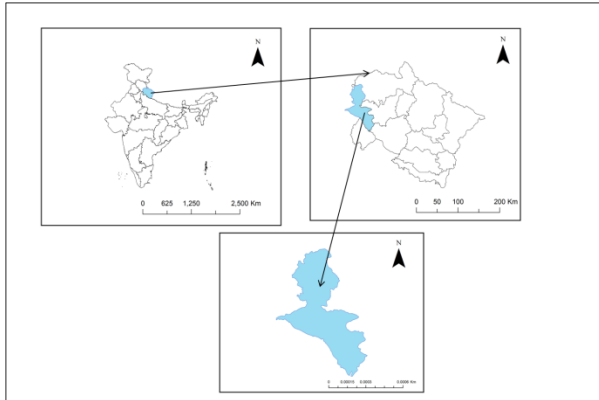
STUDY AREA

Fig 1: Location Map of study area

The study area which we have selected is Dehradun district which is situated in North West corner of Uttarakhand state and extends from North Latitude 29^0 58' to 31^0 02' 30" and East Longitude 77^0 34' 45" to 78^0 18' 30". The district stretches from the Ganges river in the east to the Yamuna river in the west, and from the Terai and Shivaliks in the south and southeast to the Great Himalaya in the northwest. The total area of Dehradun district is 3088 km^2 with an average altitude of 640 m above msl. The district encompasses lofty peaks of the Outer Himalayas as well as the Dun Valley with climatic conditions nearly similar to those in the plains. The climate of the district, in general, is temperate. In the hilly regions, the summer is pleasing but in the Doon Valley, the heat is often intense. Generally, the month of May and early part of June is hottest with mean temperatures shooting upto 36.2^0C at Dehradun and 24.8^0C at Mussoorie. Winter starts from November and continue upto February. The mean daily maximum temperature during winter is 19.1^0C at Dehradun and 10.2^0C at Mussoorie. The mean daily minimum temperature in January is 6.1^0C at Dehradun and 2.5^0C at Mussoorie. The district receives an average annual rainfall of 2073.3 mm. Most of rainfall is received during the period from June to September, July and August being the wettest months.Most of the annual rainfall is received Viewing conducive physiographic and climatic conditions of the district, which supports the mulberry plantation this area has been chosen.

METHODOLOGY

The methodology for identification of potential areas for sericulture development involves evaluation of land and water resources requirements for growing silkworm food plants as well as rearing of silk worms**.** The assessment of suitability of land for sericulture involves matching the land qualities with requirements of silkworm food plants and matching of environmental conditions for silk rearing. The basic theory of FAO framework **[2]** for land evaluation was adopted here to define suitability for mulberry. Cultivatable wasteland categories have been evaluated for introducing sericulture practice in new areas. Under this cultivatable wasteland only three categories respectively degraded forest, land with open scrub and land with dense scrub are selected for the study of mulberry plantation which is based on the properties of the soil like soil type, soil depth, texture etc **[3]**. Soil resources created using the reconnaissance soil survey report and from the National Bureau of Soil Survey & Land Use Planning. Besides this many factors for suitability of land for sericulture various maps are generated for the study area like soil map, ground water prospects map, cultivatable map and wasteland map. This information is used for the identification for the site suitability for mulberry in the Dehradun district. The methodology adopted for the identification for site suitability units are indicated in the form of flow chart in fig.1. The details are given below:

Cultivatable Wasteland: Cultivatable wastelands has been taken from National Wasteland Inventory Project (NWIP) for Dehradun district **[4]**

Soil map: Soil resource map include different characteristics of soil like depth, drainage and texture. Soil map has been taken from National Bureau of Soil Survey & Land Use Planning **[5].**

Slope map: Slope map is derived from 30 m ASTER Digital Elevation Model (DEM).this map is reclassified based on plant requirement.

Ground Water Prospects Map: This map has been taken from Rajiv Gandhi National Drinking Water Mission project. According to criteria water availability is classified as very good, good, fair, fair to moderate and poor.

Degree of limitation and suitability classes for generation of soil map, ground water prospect map and slope map is mentioned in *Table. 1*

Table.1 Criteria for evaluation of site suitability for mulberry plantation

Soil-site characteristics	Degree of limitation & Suitability class					
	Unit	0 None	1 slight	2 Moderate	3 Severe	4 Very severe
		S1 (Highly suitable)		S2 (Moderately suitable)	S3 (Marginally suitable)	N (Not suitable)
Topography and landscape						
Slope (for hilly area)	(degree^0)	1-3 (Very gently sloping)	3-5 (Gently sloping)	5-10 (Moderately sloping)	10-15 (Strongly sloping)	15-35 (Moderately Steep to steep slope)
Soil characteristics						
Drainage	Class	Well	Well	Moderately well	Imperfect	Poor, Excessive
Ground water		Very good	Good	Fair	Fair to moderate	Poor
Texture		Loam	Clay loamy	Fine loamy	Coarse loamy	Sandy fragmental
Depth	Cm	Very deep (>150)	Deep (100-150)	Deep-mod. Deep (100-50)	Shallow (25-50)	Very shallow (<25)

Table.2 Evaluation of Climatic Suitability for Mulberry Plantation

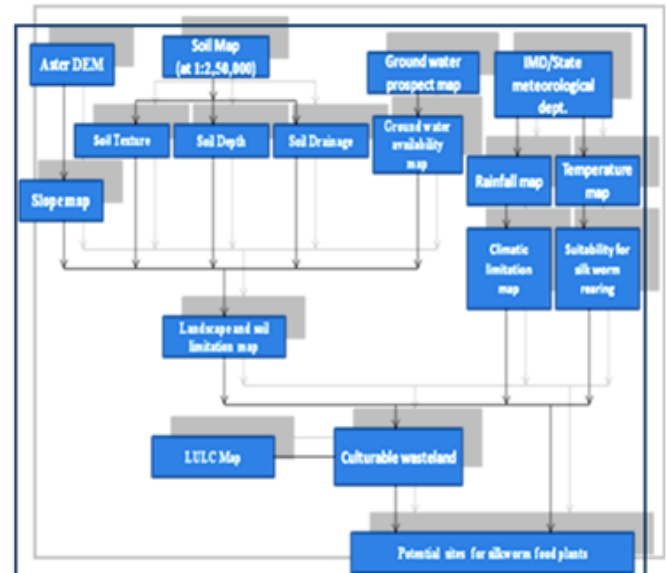| Climatic characteristics	Suitability classes			
	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Mean temperature in growing season(^{0}C)	20-30	30-37	30-37	<15 and >37
Total rainfall (mm)	500-750	750-2000	2000-3400	<500 and >3400

Figure 2. Methodology of Evaluation of Site Suitability for Mulberry Plantation [6]

Integration of different layers: Based on above mentioned methodology, integration of different layers such as cultivable wasteland, soil resource map, slope map, DEM, ground water prospect map and climatic parameters has been done.

Based on criteria or limitations rating for evaluation for site suitability classes have been decided and graded as highly suitable (S1), moderately suitable (S2), marginally suitable (S3), and not-suitable (N) which is mentioned in Table 3 .

Table.3 Criteria for Determination of Land Suitability Classes

Land Suitability Classes	Limitation
S1 highly suitable	Land units with no or 3 slight limitations
S2 moderately suitable	Land units with more than 3 slight limitations or no more than 3 moderate limitation
S3 marginally suitable	Land units with more than no more than 3 moderate limitation or more severe limitation
N not suitable	Land unit with very severe limitation

RESULTS

Results showing that out of available cultivatable wasteland area of Dehradun district about 271.42 ha area is moderately suitable, 205.25 ha area is marginally suitable and 25181.15 ha area is not suitable for mulberry plantation in fig.2.

Table.4 Result shows Suitability Classes with area (ha)

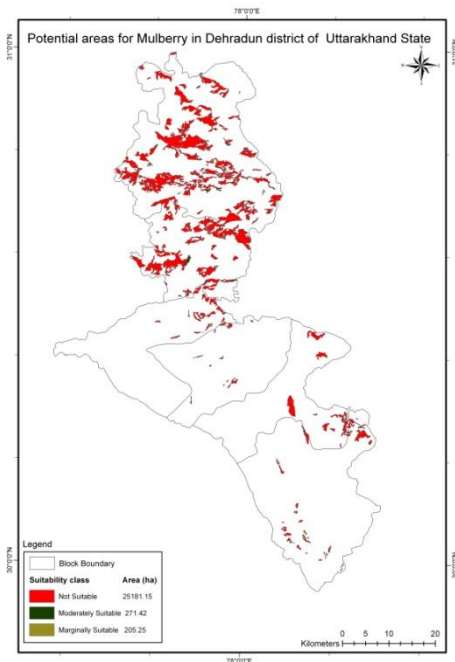| S.no.	Suitability criteria	Area (ha)
1	Highly suitable	-----
2	Moderately suitable	271.42
3	Marginally suitable	205.25
4	Not suitable	25181.15

Figure 3: Suitable Sites in Dehradun District of Uttarakhand state for Mulberry Plantation

CONCLUSIONS

The present study utilized the geospatial techniques for mapping of suitable sites for mulberry cultivation. Presence of more amount of moderately suitable area for mulberry cultivation than marginally suitable area is favorable for mulberry plantation. Use of wastelands for this purpose will ease the pressure on other land use. Increase of area under mulberry plantation will also provide additional employment opportunities to various stakeholders present in the study area.

ACKNOWLEDGMENTS

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