

# Assessment of Potential Guayule Availability for Natural Rubber Production in the Continental US

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## INTRODUCTION

- Natural rubber (NR) is vital to the global economy, supporting various industries from consumer goods to healthcare, automotive, and aerospace.
- Currently, the sole commercial source of NR is the rubber tree (*Hevea brasiliensis*), mainly cultivated in Southeast Asia.
- This heavy reliance on a single species and region poses significant risks because of disease vulnerability, weather extremes, market volatility, and geopolitical instability.
- The United States (US) depends almost entirely on imported Hevea NR, making its supply chain highly susceptible to disruptions.
- Diversifying NR sources by exploring alternative rubber-producing crops is thus essential to mitigate these risks.
- Guayule (*Parthenium argentatum*) is a promising alternative which offer superior pest resistance capability and adaptability to diverse climates.
- Guayule is well-suited to arid and semi-arid environments, requiring minimal rainfall and growing best in sandy, well-drained soils.
- Given these distinct growth requirements, identifying suitable regions within the US for large-scale guayule cultivation is crucial for enhancing domestic NR production and ensuring supply chain resilience.



## OBJECTIVES

- Develop a suitability map for guayule cultivation by applying multicriteria evaluation and Geographic Information Systems (GIS) techniques.
- Assess the production potential of guayule NR across the continental US.

## METHODOLOGY

The methodology consists of five key steps, detailed in the following sections (Steps 1–5), with each step building upon the previous one.

### Suitability Assessment

- To assess suitability for guayule cultivation, the analysis incorporated climate parameters (temperature, precipitation, and snow cover), soil characteristics (soil texture and pH), and topographic features (elevation). (see Step 1)
- The input datasets were reclassified based on optimal growth conditions for guayule. (see Step 2)
- A suitability map was generated by applying weighted parameters derived from the Analytical Hierarchy Process (AHP), as detailed in Table 1.

Table 1. Parameter weighting for suitability assessment

Parameters	Temperature	Precipitation	Snow Cover	Soil Texture	Soil pH	Elevation
Weight	0.35	0.16	0.06	0.11	0.05	0.27

Table 2 presents the pairwise comparison matrix utilized in the AHP to derive the criterion weights.

## METHODOLOGY AND RESULTS

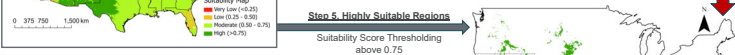
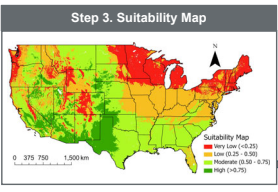
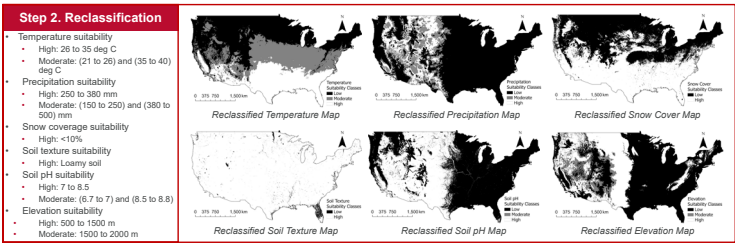
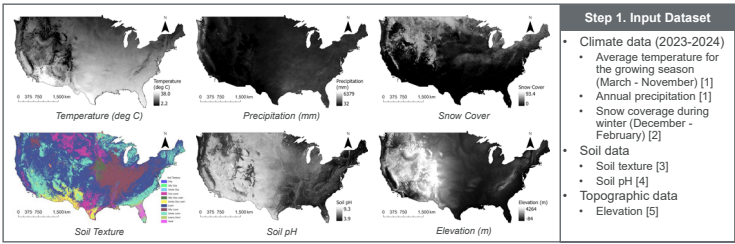


Table 2. Pairwise comparison matrix used for the AHP

Criteria	Temperature	Precipitation	Snow Cover	Soil Texture	Soil pH	Elevation
Temperature	1	3	5	3	4	2
Precipitation	0.33	1	4	2	3	0.50
Snow Cover	0.20	0.25	1	0.33	2	0.17
Soil Texture	0.33	0.50	3	1	2	0.33
Soil pH	0.25	0.33	0.50	0.50	1	0.20
Elevation	0.50	2	6	3	5	1

Fig. Highly suitable region for guayule cultivation

- Post-processing steps included removing unsuitable land cover types such as water bodies, wetlands, forests, and developed areas, based on the 2019 National Land Cover Database (NLCD). (see Step 4)
- Finally, a suitability threshold of 0.75 was applied to the masked map to identify highly suitable regions for guayule cultivation.

- ### Software
- Suitability assessment was performed in Google Earth Engine (GEE) platform.
  - ArcGIS Pro was utilized for map visualization and final output generation.

## DISCUSSION

- The analysis identified the most suitable regions for guayule cultivation in Texas, New Mexico, Arizona, and California.
- Other feasible areas were sparsely distributed across Oklahoma, Kansas, Colorado, and Nevada.
- A total of 0.84 million km<sup>2</sup> (84 million ha) of land was classified as highly suitable for guayule cultivation.
- Given that NR yield from guayule varies based on plant age, irrigation practices, and specific cultivars, potential rubber production was estimated under different yield scenarios (300–1000 kg/ha/yr) [6].
  - Minimum yield: 25.2 million metric tons (MT) per year
  - Average yield: 54.6 million MT per year
  - Maximum yield: 84 million MT per year
- For context, the US consumed approximately 1 million MT of natural rubber (NR) in 2022 [7]. This suggests that even a fractional adoption of guayule cultivation within the identified regions could significantly contribute to meeting the annual NR demand.

## CONCLUSIONS AND FUTURE WORKS

- A GIS-based model integrating climate, soil, and topographic parameters was developed to identify the most suitable regions for guayule cultivation.
- The multicriteria evaluation revealed that Texas, New Mexico, Arizona, and California possesses the arid to semi-arid conditions ideal for optimal guayule production.
- The findings indicate that the US has the potential to produce between 25.2 and 84 million metric tons of natural rubber (NR) annually from guayule.
- Future work will focus on identifying optimal locations for rubber extraction facilities based on the clusters of suitable cultivation areas identified in this study.

## SIGNIFICANCE

This research provides critical insights into the feasibility of establishing a sustainable and resilient alternative NR industry in the US, helping to mitigate future supply chain risks and market volatility.

## ACKNOWLEDGEMENT

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