Table S1: The environmental predictors considered in species distribution modeling of *R. arboreum*.

Code	Name of Variable and Description	Database	Resolution	Unit
Bio1	Annual mean temperature	Worldclim	30 arc s	^{0}C
Bio2	Mean diurnal range	Worldclim	30 arc s	^{0}C
Bio3	Isothermality	Worldclim	30 arc s	Percent
Bio4	Temperature seasonality	Worldclim	30 arc s	^{0}C
Bio5	Maximum temperature of warmest month	Worldclim	30 arc s	^{0}C
Bio6	Minimum Temperature of Coldest Month	Worldclim	30 arc s	^{0}C
Bio7	Temperature annual range	Worldclim	30 arc s	^{0}C
Bio8	Mean temperature of wettest quarter	Worldclim	30 arc s	^{0}C
Bio9	Mean Temperature of Driest Quarter	Worldclim	30 arc s	^{0}C
Bio10	Mean temperature of warmest quarter	Worldclim	30 arc s	^{0}C
Bio11	Mean Temperature of Coldest Quarter	Worldclim	30 arc s	^{0}C
Bio12	Annual Precipitation	Worldclim	30 arc s	Mm
Bio13	Precipitation of Wettest Month	Worldclim	30 arc s	Mm
Bio14	Precipitation of Driest Month	Worldclim	30 arc s	Mm
Bio15	Precipitation seasonality	Worldclim	30 arc s	Percent
Bio16	Precipitation of wettest quarter	Worldclim	30 arc s	Mm
Bio17	Precipitation of driest quarter	Worldclim	30 arc s	Mm
Bio18	Precipitation of warmest quarter	Worldclim	30 arc s	Mm
Bio19	Precipitation of Coldest Quarter	Worldclim	30 arc s	Mm

Elevation	Elevation	SRTM DEM	30 arc s	meter
Aspect	Aspect	SRTM DEM	30 arc s	Nil
Slope	Slope	SRTM DEM	30 arc s	Degree
Hillshade	Hillshade	SRTM DEM	30 arc s	Degree
Bdod	Bulk Density	SoilGrids	7.5 arc s	cg/cm^3
Cec	Cations Exchange Capacity (pH: 7)	SoilGrids	7.5 arc s	cmol/kg
Cfvo	Volumetric fraction of coarse fragments (>2 mm)	SoilGrids	7.5 arc s	cm^3/dm^3
Clay	Clay Contents	SoilGrids	7.5 arc s	g/kg
Nitrogen	Total Nitrogen	SoilGrids	7.5 arc s	cg/kg
Ocd	Organic Carbon Density	SoilGrids	7.5 arc s	hg/dm^3
Phh20	Soil pH 10	SoilGrids	7.5 arc s	Nil
Sand	Sand Contents	SoilGrids	7.5 arc s	g/kg
Silt	Silt Contents	SoilGrids	7.5 arc s	g/kg
Soc	Soil Organic Carbon	SoilGrids	7.5 arc s	dg/kg

Table S2: The details of Shared Socioeconomic Pathways (SSPs) for Climate Projections.

SSP Scenario	Narrative Title	Mitigation Challenges	Adaptation Challenges	Radiative Forcing (W/m^2)	Warming by 2100	CO_2 (ppm)	Key Characteristics
SSP126	Sustainability – Taking the Green Road	Low	Low	2.6	~1.5–2.0 °C	420–490	Green growth, inclusive development, strong environmental regulation, clean technologies.
SSP245	Middle of the Road	Medium	Medium	4.5	~2.0–3.0 °C	540–670	Current trends continue, moderate policy efforts, uneven regional development.
SSP370	Regional Rivalry – A Rocky Road	High	High	7.0	~2.8–4.0 °C	750–870	Fragmented world, regional conflicts, slow economic growth, limited cooperation.
SSP585	Fossil-fueled Development – Taking the Highway	Low	High	8.5	~3.3–5.0 °C	900–1100	Rapid economic growth, energy-intensive lifestyles, high fossil fuel use, delayed action.

These projections were utilized to predict potential environmental changes and their effects on species distribution of *R. arboreum*.

Table S3: Environmental variable's relative contribution and permutation importance to the MaxEnt models of *R. arboreum*

Variable	Name of predictor variable	Percent contribution (%)	Permutation importance (%)
Bio_4	Temperature seasonality	58.6	4.5
Bio_15	Precipitation seasonality	14.8	15.8
Bio_17	Precipitation of driest quarter	8.3	7.8
Bio_11	Mean Temperature of Coldest Quarter	6.2	43.5
CFVO	Volumetric fraction of coarse fragments (>2 mm)	6.2	26.5
Bio_3	Isothermality	3.5	1.5
Bio_7	Temperature annual range	2.5	0.4

Table S4: Number of different life forms recorded from study area

Sr. No.	Parameter	Total number
1	Families	9
2	Species	17
3	Trees	9
4	Shrubs	8

Table S5: List of tree and shrub species identified in the study area with their families

Trees		Shrubs	
Species	**Family**	**Species**	**Family**
Pinus roxburghii	Pinaceae	*Berberis lycium*	Berberidaceae
Cedrus deodara	Pinaceae	*Rubus ellipticus*	Rosaceae
Quercus leucotricophora	Fagaceae	*Ribes alpestre*	Grossulariaceae
Myrica esculenta	Myricaceae	*Daphne papyracea*	Thymelaeaceae
Pyrus pashia	Rosaceae	*Viburnum grandiflorum*	Adoxaceae
Prunus cerasoides	Rosaceae	*Mahonia napaulensis*	Berberidaceae
Picea smithiana	Pinaceae	*Rhododendron campanulatum*	Ericaceae
Quercus semecarpifolia	Fagaceae	*Berberis asiatica*	Berberidaceae
Rhododendron arboreum	Ericaceae		

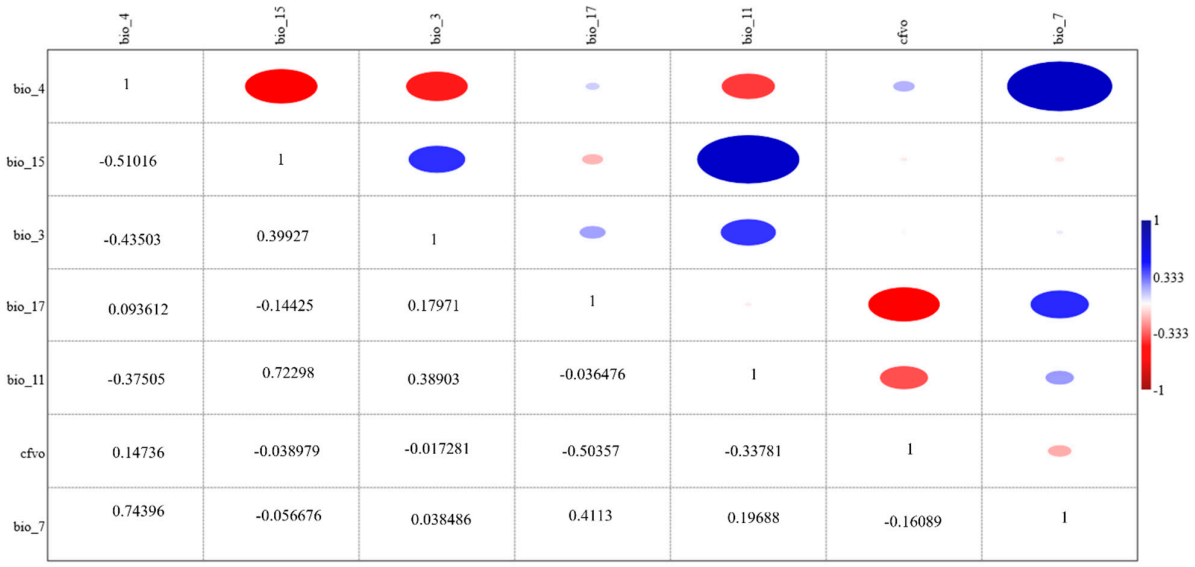


Figure S1: Pearson correlation analysis of significant environment variables for *R. arborem* ($-0.8 \leq r \leq +0.8$).

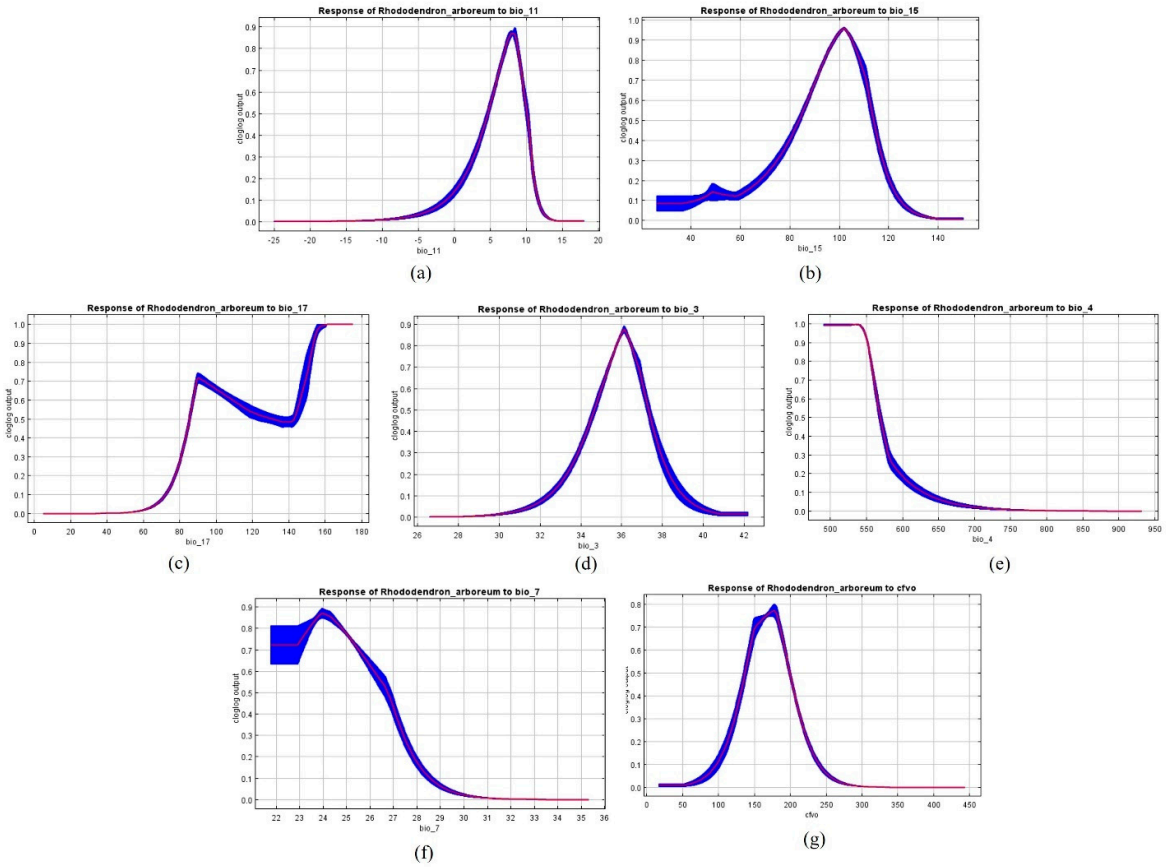


Figure S2: Response curves illustrating the relationship of predicted probability of *R. arboreum* occurrence with (a) Mean temperature of coldest quarter (Bio_11) (b) Precipitation seasonality (Bio_15) (c) Precipitation of driest quarter (Bio_17) (d) Isothermality (Bio_3) (e) Temperature seasonality (Bio_4) (f) temperature annual range (Bio_7) and (g) Volumetric fraction of the coarse soil fragments (CFVO). Values shown are average over 15 replicate runs: blue margins showed standard deviation calculated over 15 replicates.