Climate change threaten endemic plants in the Eastern Afromontane Rainforest of Ethiopia: the case of *Vepris dainellii* (Pic.Serm.) Kokwaro

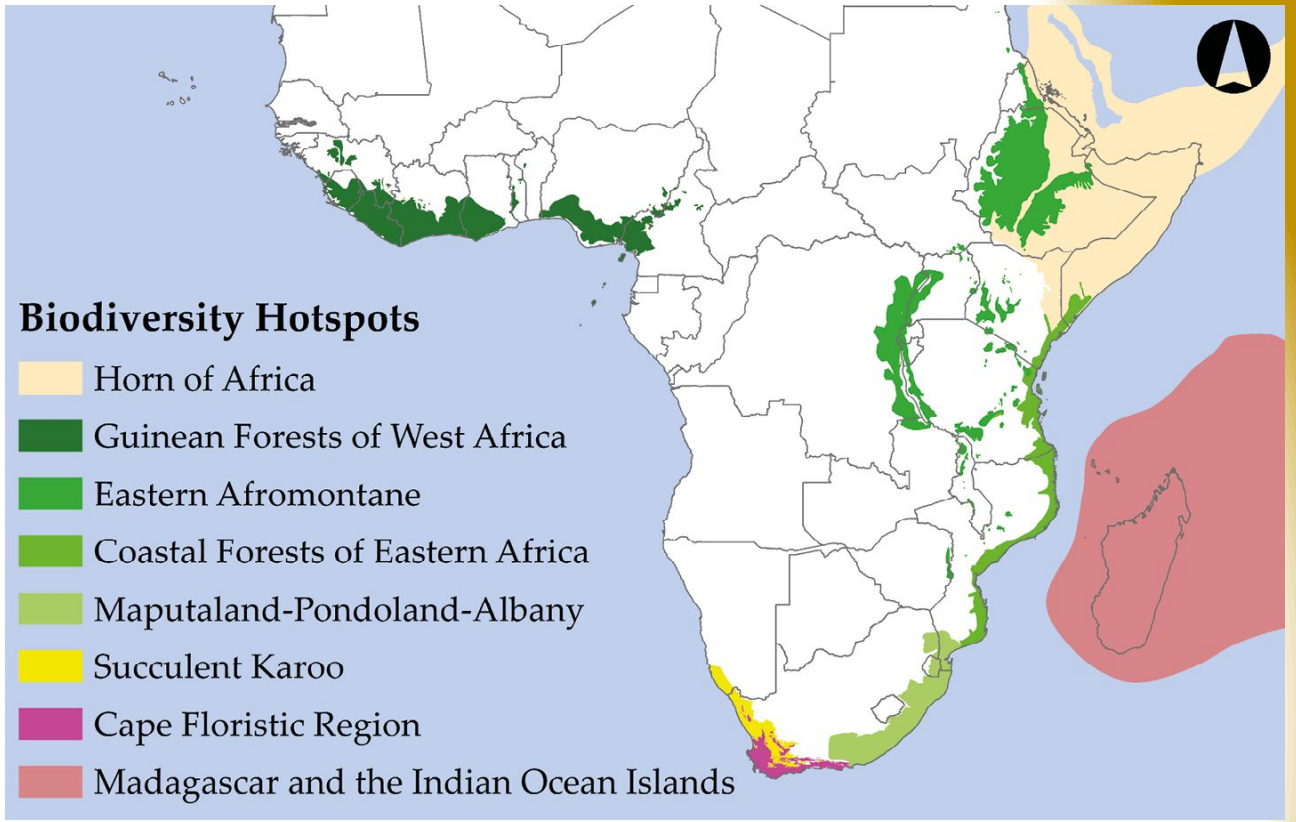
By Fikadu Erenso

NileWell Scientist-Journalist Coproduction Fellowship 2024

October 08/2025

Introduction

- Ethiopia has a wide variation in altitude ranging from **125 m** below sea level to the highest peak over **4533 m** above sea level (Asefa et al., 2020)



- The country falls within **two** biodiversity hotspots,
  1. the Eastern Afromontane and,
  2. the Horn of Africa (Fashing *et al.*, 2022)

- **home to numerous endemic plant species**
  - ~**6,500** species of plants (600 endemic) (Demissew et al., 2021a),
    - Among these *Vepris dainellii* belonging to the Rutaceae family, is **endemic to Ethiopia**
    - It flourishes in restricted habitats.

Vepris dainellii (Pic.Serm.) Kokwaro

- It **grow** particularly within the lowland altitudes ranging from 1050 to 2500 meters (Bekele, 2007).
- It is locally useful: the fruit are collected (ripe fruit is sold, used as an additive to coffee), and
- The wood is used for firewood, timber, farm tools (Denu & Desissa, 2013).
- It has **medicinal uses** in treating certain bacterial infections, stomach ach and malaria (Robi, 2016).
- There is evidence of overharvesting of mature fruits, which reduces regeneration,

Impacts of Climate Change on *Vepris dainellii*

- A recent systematic review finds that endemic plant species in Ethiopia are under threat from
  - *climate change-induced land conversion*, as well as from
  - grazing, fuelwood/timber production, and cropland expansion (Abro et al., 2024).
- Climatic change is expected to shift habitat suitability, if the current suitable range moves upward or to cooler, wetter microhabitats, *V. dainellii* populations at lower elevations (around 1,050 m) may lose habitat.
- As climate change leads to changes in seasonal rainfall (less precipitation in dry periods, more variability, possibly longer dry seasons), *V. dainellii*, being in montane forests, may suffer moisture stress.
- Increased heat stress on adult trees, changes in growth rates.

- To better understand the exact impact of climate change on *Vepris dainellii:*

  - This study aims to project its future distribution under varying climate scenarios and a comprehensive model that highlights potential suitable habitats

Data collection

1. Species Occurrence record for *V. dainellii*

- From field survey =6,
- National Herbarium of Ethiopia (ETH), Addis Ababa University =14 and,
- The Global Biodiversity Information Facility (GBIF; www.gbif.org/) =34 records , = **54** occurrence sites

2. Environmental variables

The bioclimatic variables, from WorldClim (https://www.worldclim.org/data/cmip6/cmip6_clim30s.html)
For the projected climate scenarios, (HadGEM3-GC31-LL) for the periods, 2041-2060 and 2061-2080

Environmental Variables Selection

- The Variance Inflation Factor (VIF) was calculated for each bioclimatic variable to identify any high correlations among them and to enhance model stability and prediction accuracy in R version 4.2.2.
- Systematically all variables were eliminated with VIF values exceeding a predetermined threshold.
- These nine bioclimatic variables were retained for the species distribution models of *Vepris dainellii*.

Bio3: Isothermality (Bio2/Bio7) (×100)

Bio4: Temperature Seasonality (standard deviation ×100)

Bio7: Temperature Annual Range

Bio9: Mean Temperature of Driest Quarter

Bio13: Precipitation of Wettest Month

Bio14: Precipitation of Driest Month

Bio15: Precipitation Seasonality (Coefficient of Variation)

Bio18: Precipitation of Warmest Quarter

Bio19: Precipitation of Coldest Quarter

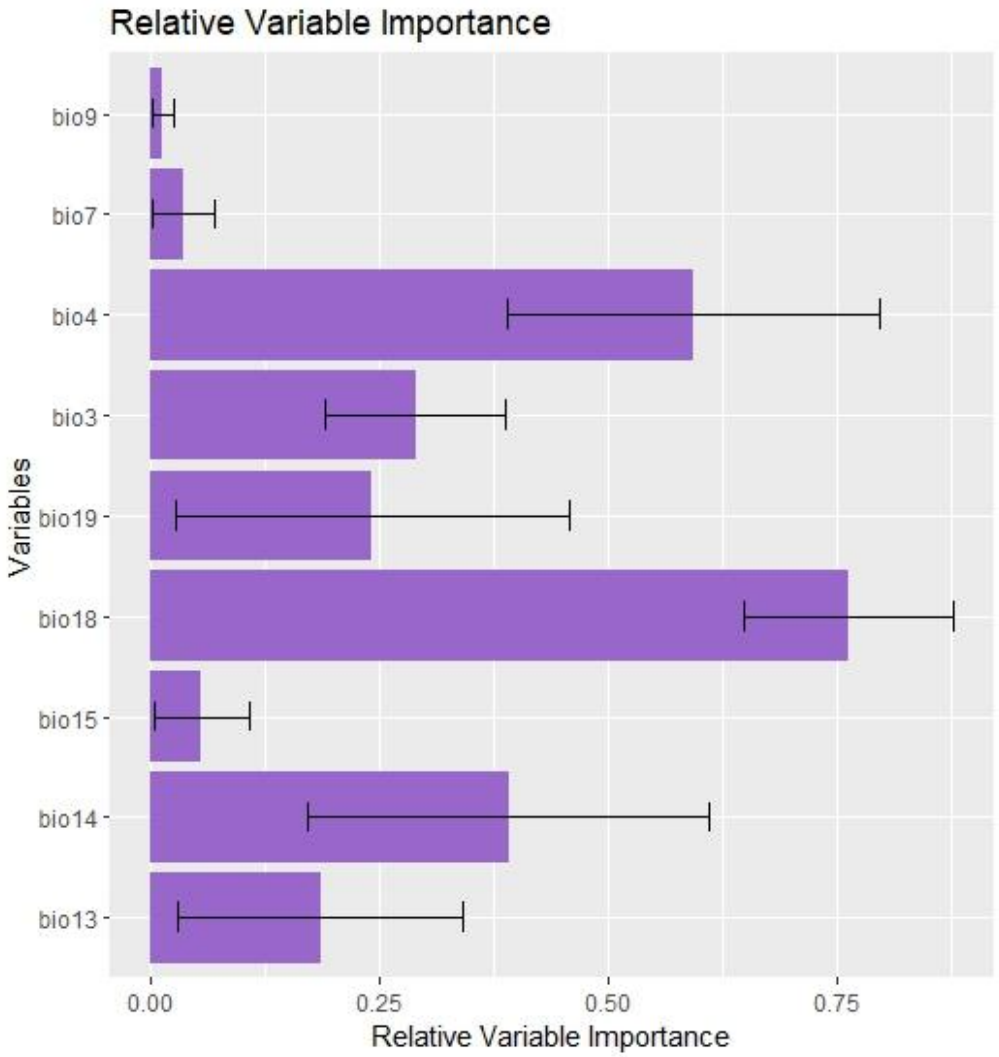
Model Evaluation and Validation

four modelling techniques examined : Maximum Entropy (MaxEnt), Generalized Linear Models (GLMs), Random Forest (RF), and Boosted Regression Trees (BRT)

Table 1: Model of SDMS mean performance (per species) using test dataset (generated using partitioning)

Methods	AUC	COR	TSS	Deviance
GLM	0.91	0.68	0.81	0.17
BRT	0.94	0.76	0.84	0.16
RF	0.94	0.81	0.87	0.12
MaxEnt	0.95	0.72	0.86	0.17

Variable importance charts



The distribution of *V. dainellii* was shown to be most affected by:

- Precipitation of Warmest Quarter (bio18),
- Temperature Seasonality (sd ×100) (bio4),
- Precipitation of Driest Month (bio14), and,
- Precipitation Seasonality (bio3)

Figure 1: Relative Variable importance of *V. dainellii* distribution

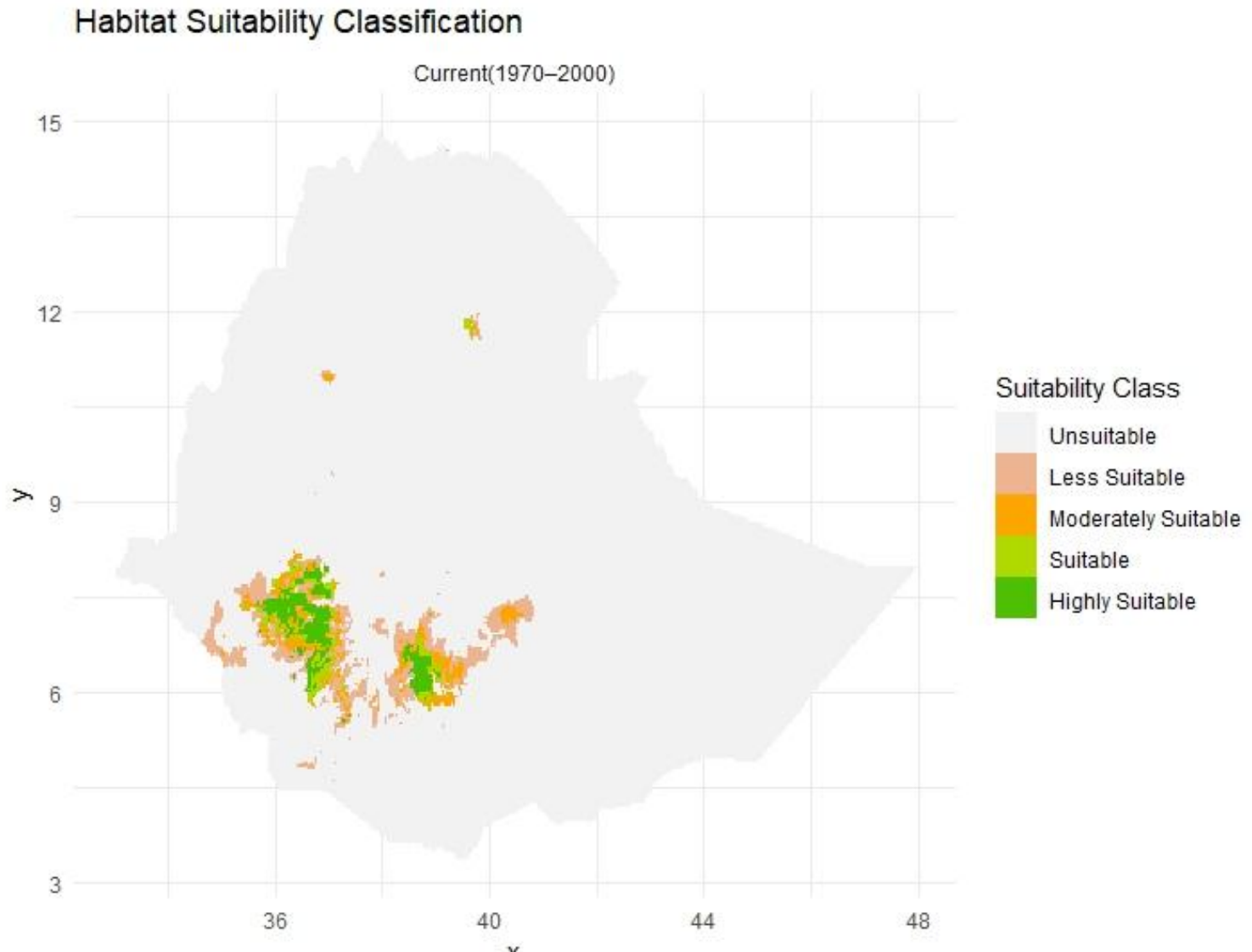


Figure 2: Predicted habitat suitability classification of *Vepris dainellii* under current (1970–2000) climate scenario

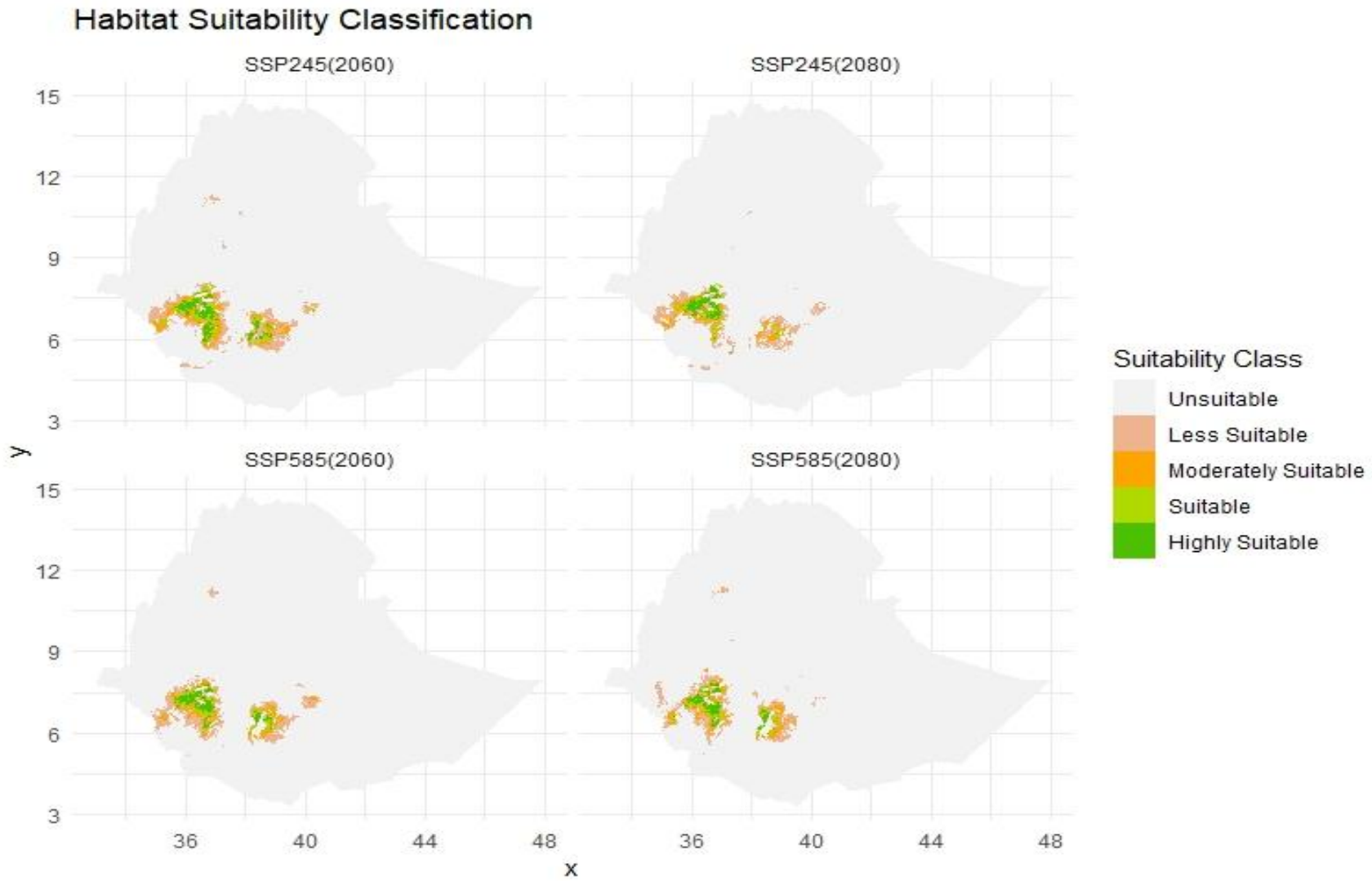
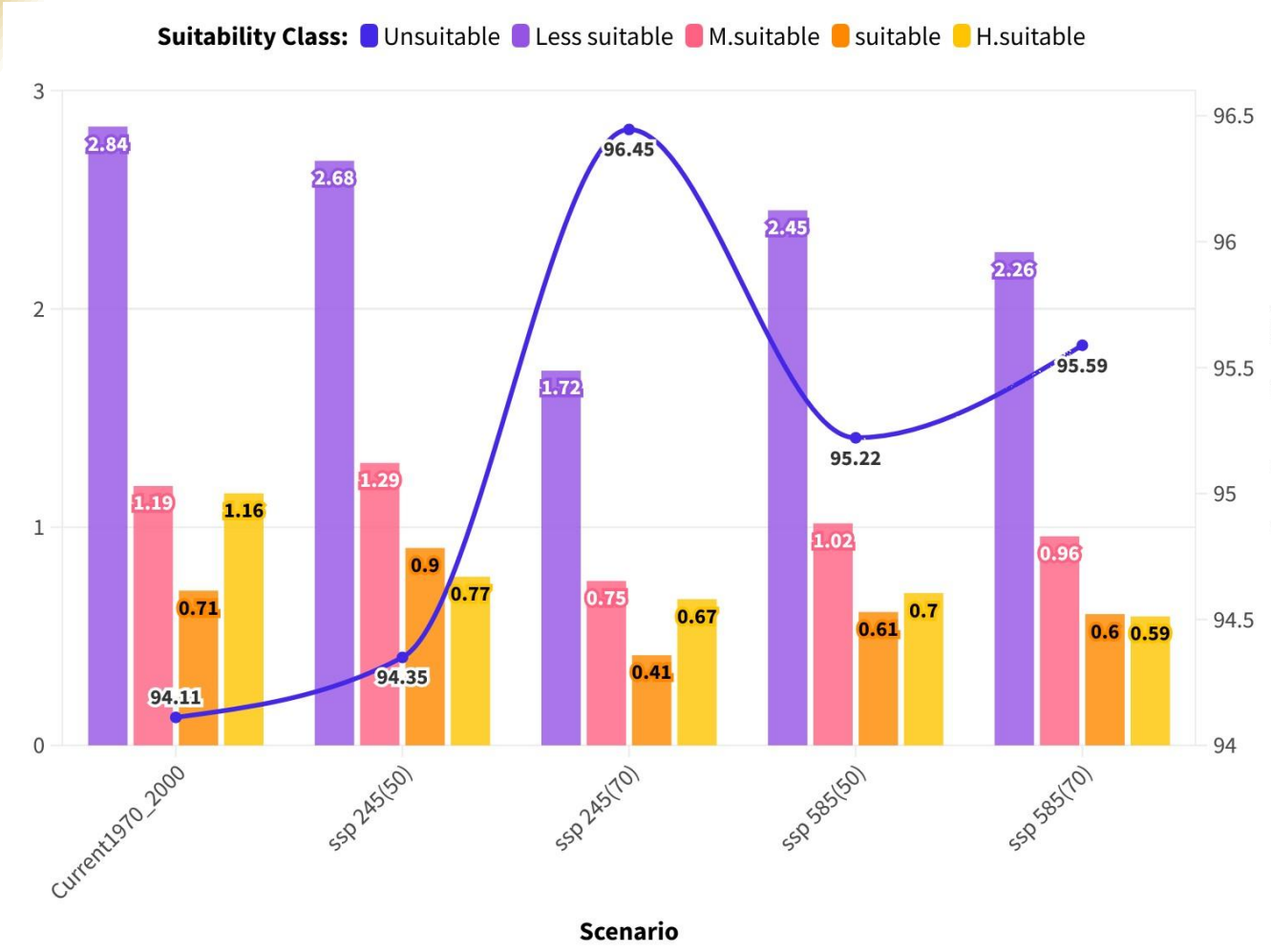


Figure 3: Predicted habitat suitability classification of *V. dainellii* under projected future climate change scenarios (SSP245(2050), SSP245(2070), SSP585(2050), and SSP585(2070))



Summery

- The model reveals a concerning trend of decreasing suitable habitats for *V. dainellii* under both projected future climate scenarios.
- certain bioclimatic variables significantly influence habitat suitability, particularly those related to precipitation and temperature seasonality.

Figure 4: The proportion of habitat suitability area changes predicted for *V. dainellii* under different climate change scenarios.

The way forward

- ✔ Sustainable Management Strategies
- ✔ Community Engagement
- ✔ Collaborative Approaches
- ✔ Focused Research and Monitoring

Thank you!!