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Impact of climate change on the geographical areas suitable for cultivation and conservation of neglected underutilized species: the case of the tamarind tree in Benin

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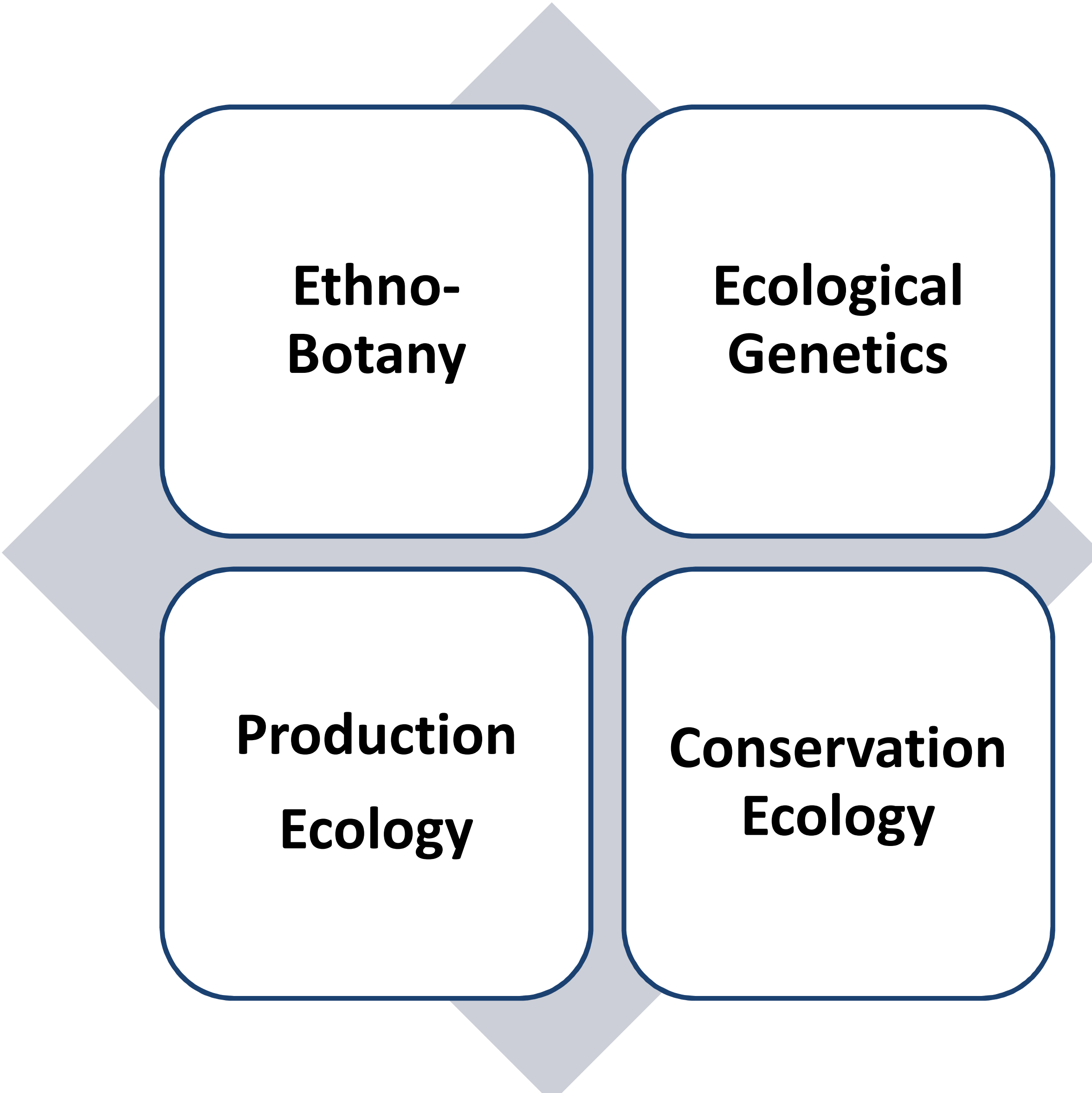
Fandohan et al., 2013. BASE: 450-462

BACKGROUND

Increasing interest in integration of indigenous NUS into African farming systems, **as a key element** in strategies towards achieving MDG 1 and 3 (**i.e., eradicating hunger and extreme poverty, and empower women**).

State of knowledge



Huge data base on NUS and their potentials is available

But concrete actions and policies are yet to be taken in most cases

Besides, there is little literature on how to account for climate change when integrating NUS into formal production systems

Conservation under Climate Change: a Further problem to address

- Selection of preferred varieties in the domestication processes often drives genetic depletion, if there are no effective conservation strategies in place that ensure the perpetuation of wild relatives

- Yet, how will static bio-reserve networks stand the conservation of indigenous NUS under climate change?

Scientific evidences are indicating that some key indigenous **NUS** have been introduced into **dry land Africa** during wetter cycles of the climate **back to 1,000 - 3,000 BP**.

Journal of Biogeography (J. Biogeogr.) (2009) 36, 1181–1193

ORIGINAL ARTICLE

Tree mortality in the African Sahel indicates an anthropogenic ecosystem displaced by climate change

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ABSTRACT

Aim Widespread reports of disappearing tree species and senescing savanna parklands in the Sahel have generated a vigorous debate over whether climate change or severe human and livestock pressure is principally responsible. Many of the tree taxa in decline are closely associated with human settlement and farming, suggesting that the parkland ecosystem may not be a natural vegetation assemblage. The aim of this study is to assess the possibility that human activities promoted the spread of taxa with edible fruit into dry Sudano-Sahelian areas during high-rainfall periods in the climate cycle.

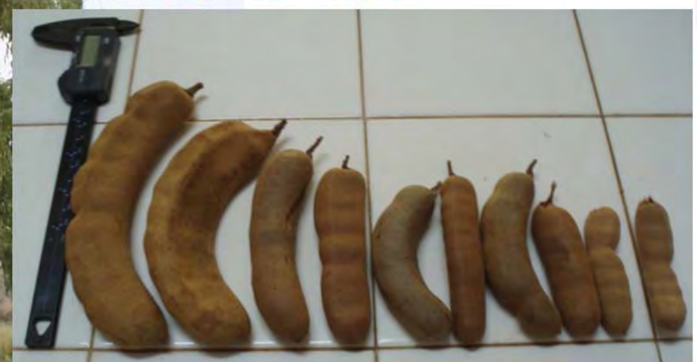
Location West African savannas (Mali, Burkina Faso, Ghana, Togo, Benin).

Key implication: Not all NUS can be sustainably grown and conserved at their current locations.
They may be either displaced or favored by climate change.

OBJECTIVE

Assess the potential impact of climate change on the geographic range of suitable areas for African NUS : the tamarind tree, *Tamarindus indica* L.

THE TAMARIND TREE, *TAMARINDUS INDICA* L.

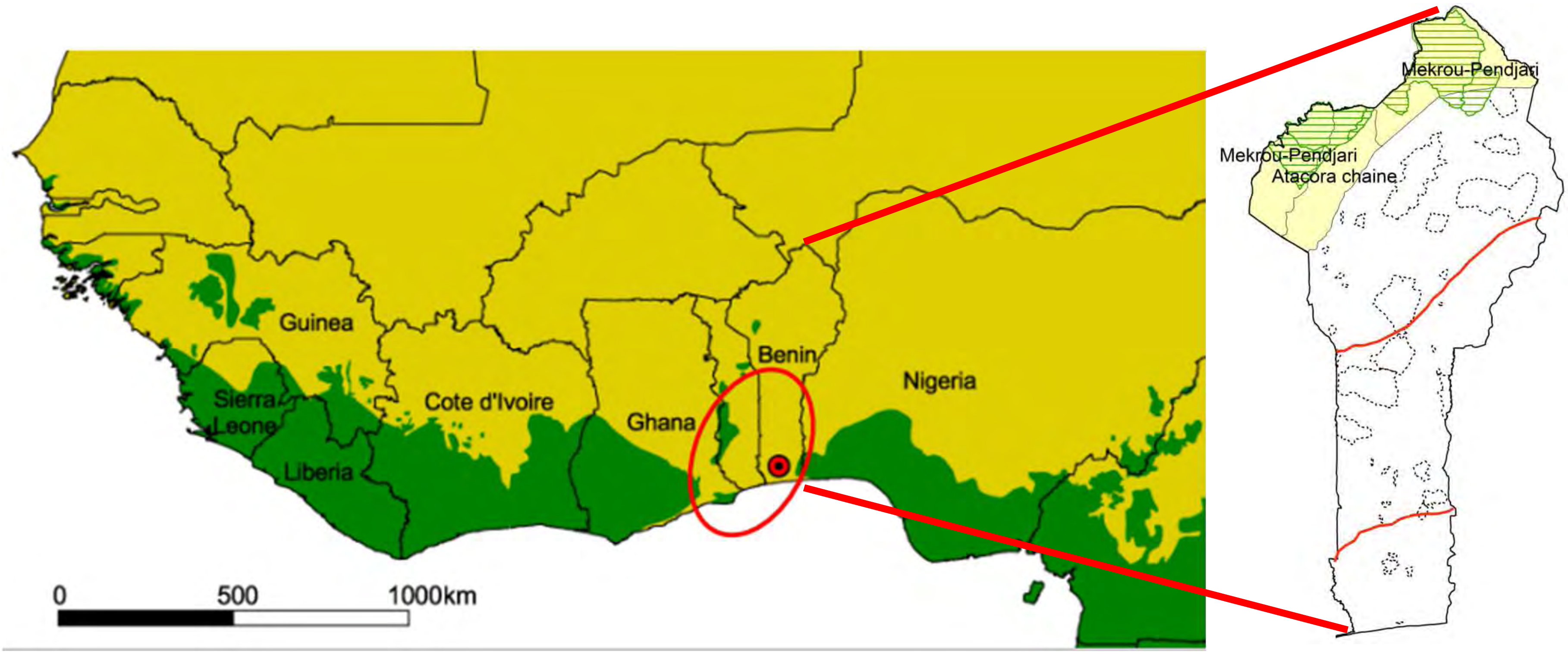


Indigeneous Fruit Tree species, Fabaceae family

Origin: Africa? India? Madagascar?

Priority Agroforestry Species in Sub-Saharan Africa.

STUDY SYSTEM (REPUBLIC OF BENIN)



Republic of Benin (6-12 °N; 0.40-3°E) located in Dahomey-Gap, West Africa, 1200 mm – 600 mm (south- north).

Dahomey-Gap is a savanna corridor which fragments the zonal West African rain forest between 0°-3°E, likely induced by climate change during the Holocene (10,000 BP).

(Salzmann *et al.* 2005; Olson *et al.* 2001).

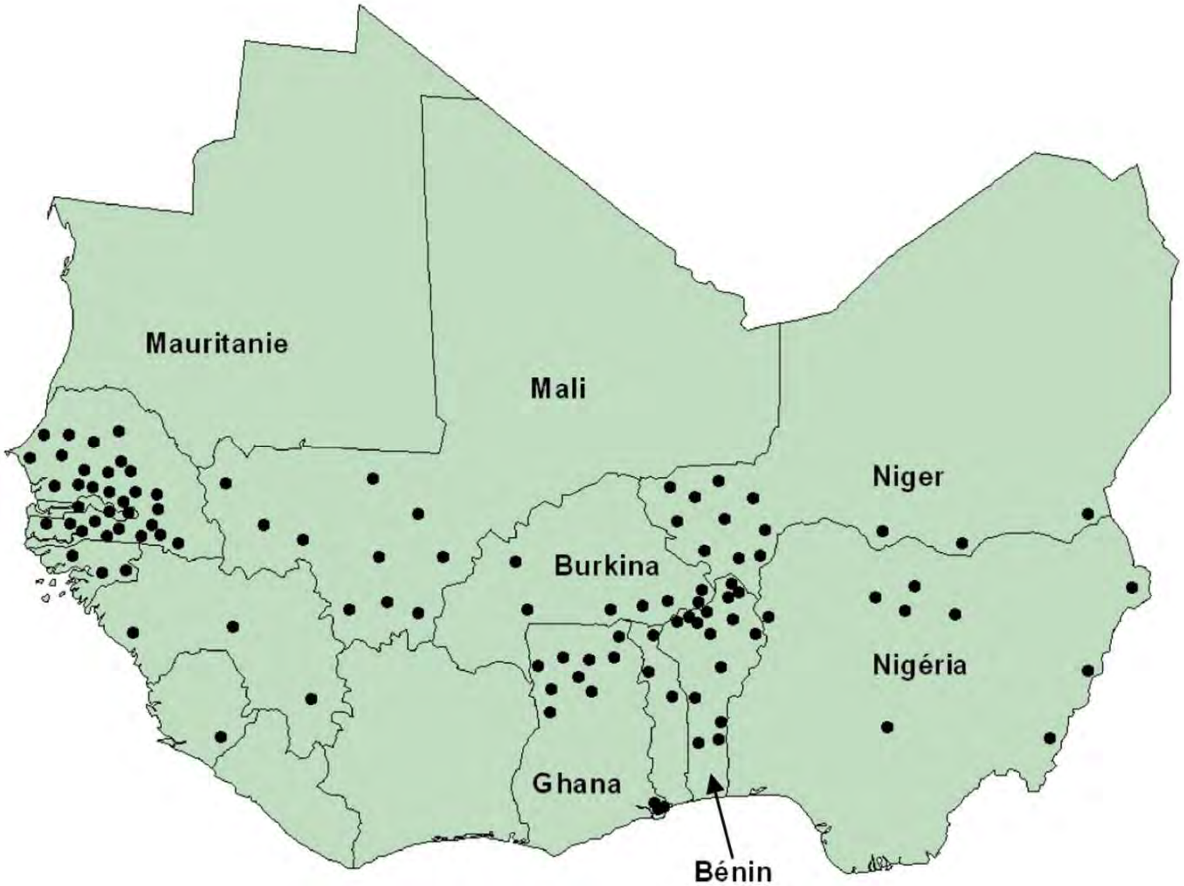
Main research questions:

✓ *What is the current range of highly suitable areas for tamarind cultivation and conservation in Benin?*

✓*How could climate change impact geographic range of these areas?*

METHODS

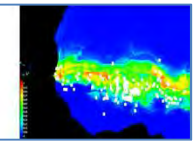
Presence records and BIOCLIM variables used



The Climate Envelop Modeling program ''MaxEnt'' (Phillips *et al.*, 2006) and ArcGIS was used to model distribution of tamarind's suitable habitats.

Input data included Location data in of *T. indica* in spanning its west african range climate data layers

Methods



Current distribution of suitable areas : historical climate data

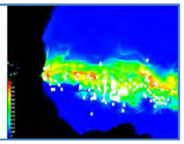
Future distribution: CCCMA, HADCM3, CSIRO compared

The A2 scenario was used (**projections at horizon 2050**)

WHY A2 scenario?: very heterogeneous world with high population growth, weak economic development and weak technological change (IPCC, 2007).

Predicts a situation reported to be more likely for Africa (Williams *et al*., 2007) in the years ahead.

Methods



Running the models

19 bioclimatic variables were derived from climate layers

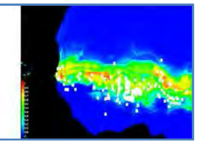
108 presence records included in the model

6/19 least correlated variables were selected ($r < 0.85$)

- Mean temperature of coldest quarter
- Temperature seasonality
- Precipitation of driest quarter
- Annual precipitation
- Precipitation of driest month
- Precipitation of warmest quarter

Elith *et al.* 2010; SRES 2000

Methods



To account for soils requirements of the species, hilly and hydromorphic areas were remored from the modelling outputs.

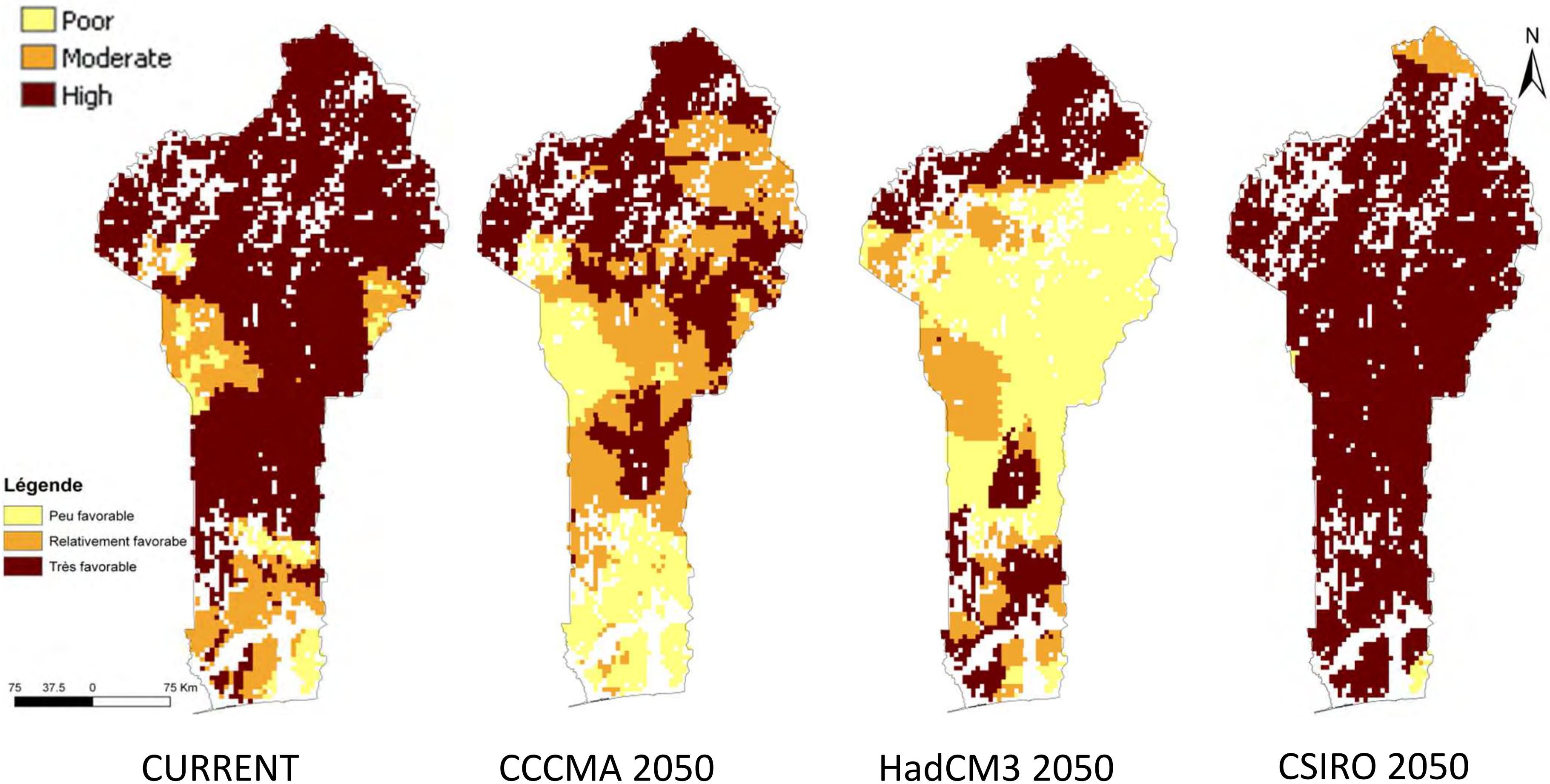
To assess the effectiveness of the national protected areas network in conserving the species, projected habitat suitability maps were overlaid with the National PAN Map

- Two occurrence probability thresholds were used to discriminate habitat suitability:
- The maximum training sensitivity and specificity threshold
- The equal training sensitivity and specificity threshold

Elith *et al.* 2010; SRES 2000

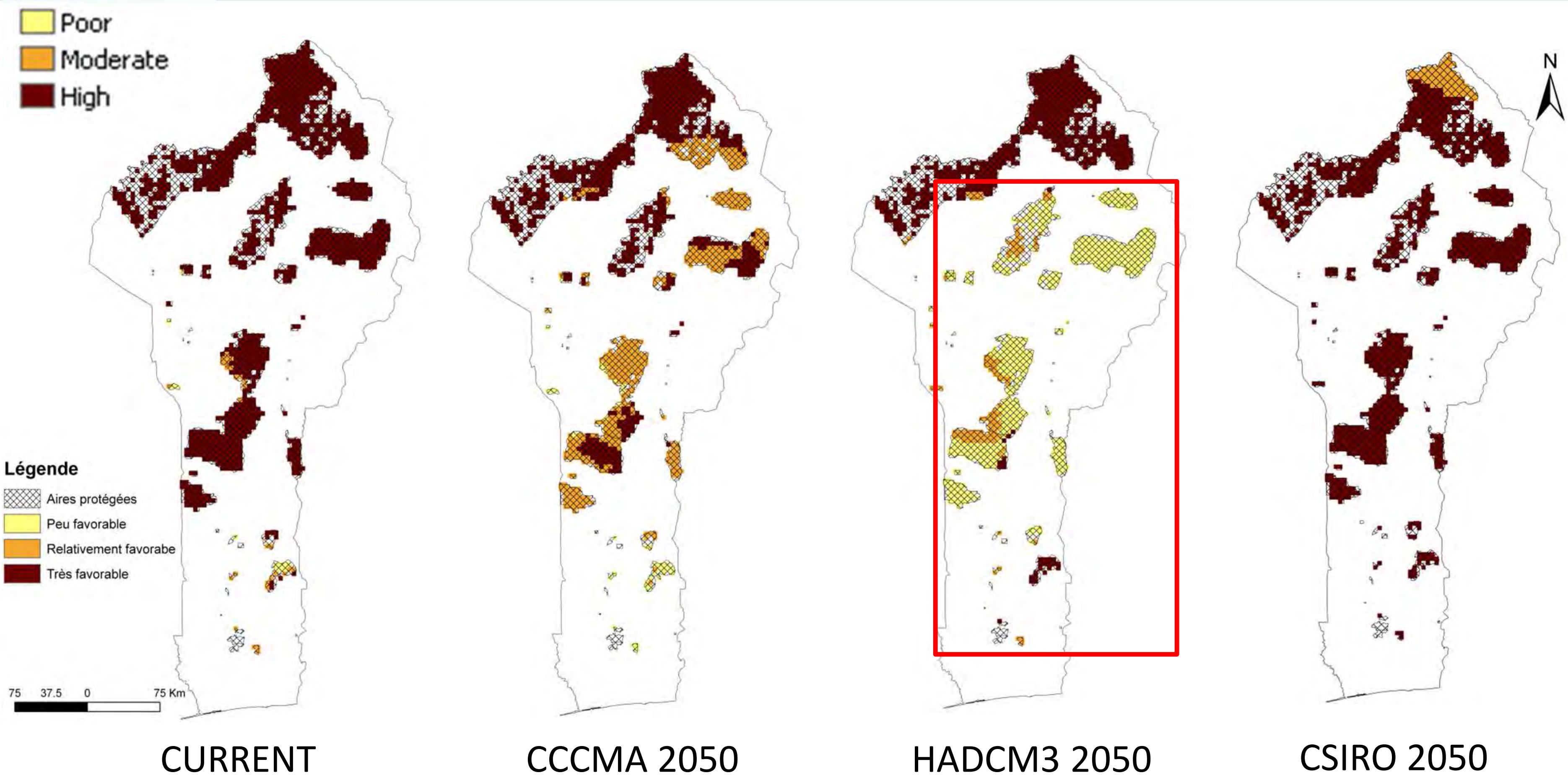
RESULTS and DISCUSSION

Effect of climate change on range of suitable habitats for *T. indica* cultivation



Up to 65 % of Benin projected to be currently suitable for T. *indica* much of which was projected to be converted into moderately and poorly suitable habitats **(CCCMA, HadCM3); or extended (CSIRO)**

Effect of climate change on range of suitable protected habitat for *T. indica*



The current reserve system proved effective (87%) in conserving highly suitable habitats of Tamarind; Much likely to critically decline in future **(CCCMA, HadCM3)** or remain suitable **(CSIRO)**

Key implications for policy

Rainfall increase (CCCMA and HadCM3 models) could convert the zones currently highly suitable (semi-arid and subhumid dry) into poorly suitable areas by 2050.

Precipitation decline (CSIRO model) could convert the zones currently poorly suitable (sub-humid humid) into highly suitable zones.

In the event of the climate becoming more arid **(CSIRO model)**, cultivation and conservation of tamarind could be possible all over Benin and might further benefit from introduction of ecotypes from more arid regions.

WAY FORWARD

Climate Envelop Modeling literature is not ready to effectively inform decision making and policy.

As the predictive capacity of climate models improves, this kind of study better informs decision-making for optimal integration of NUS in future farming systems.

Screening all candidate NUS (especially range restricted ones) using Climate change multi-scenarios to identify top climate change resilient species on which future FARMING SYSTEMS may be built in Africa.

Thanks

Not everything that counts can be counted…and,
Not everything that can be counted counts.
Albert Einstein